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ABSTRACT

Results of an initial attempt at measuring teamwork processes using computer simulation are presented, focusing on assessing team processes that emerge during the negotiation of a contract. The interaction between team members and how that interaction affects team performance were explored using a computer simulated negotiation. Participants interacted through computers using predetermined messages that were categorized as belonging to five teamwork processes. Tracking the messages gives a picture of teamwork processes. Two pilot studies involving 15 adults established the utility of the approach. Hypotheses that team processes would be positively associated with team performance and time and negatively associated with time-to-agreement and degree of fixed-pie bias were tested with 81 high school students. Results indicate that the measurement can be accomplished in a reasonably reliable and much more time-efficient manner through the computer simulation than through previous approaches. Five appendixes provide supplemental information. Twenty tables and four figures present study findings. (SLD)

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National Center for Research on
Evaluation, Standards, and Student Testing

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Project 2.1 Designs for Assessing Individual
and Group Problem Solving

Measurement of Teamwork Processes Using Computer Simulation

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MEASUREMENT OF TEAMWORK PROCESSES USING COMPUTER SIMULATION [1]

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Introduction

The National Center for Research on Evaluation, Standards, and Student Testing (CRESST) has a collaborative agreement from the Office of Educational Research and Improvement to study methodologies for the assessment of workforce competencies. In previous reports (O'Neil, Allred, & Dennis, 1992, 1994) we documented several validation studies of our measures of the negotiation subskill of an interpersonal competency (U.S. Department of Labor, 1991, 1992). In this report we present results of our initial attempt at measuring teamwork processes using computer simulation. Our team outcome measures are the same as our previous research (O'Neil et al., 1994).

In this section we cover four issues: (a) the importance of teams, (b) a taxonomy of teamwork processes, (c) teamwork processes within a negotiation context, and (d) measuring teamwork processes. The focus of our effort is on a simple but fundamental question: How do we assess team processes and outcomes such that the measurement is not only reliable and valid, but also *timely*?

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Importance of Teams

There has been an increased interest in team performance over the last 20 years attesting to its importance. Parallel efforts within the educational (e.g., Webb & Farivar, 1994; Webb & Palincsar, in press), industrial (e.g., Druckman & Bjork, 1994; Sundstrom, De Meuse, & Futrell, 1990), and military (e.g., Franken & O'Neil, 1994; Swezey & Salas, 1992) sectors have attempted to characterize, measure, and understand the constructs underlying effective teams. Although each sector focuses on different facets of teamwork and employs different paradigms, all three sectors recognize the potential of teams to increase and enhance learning, task performance, work productivity, and product quality. Indeed, one theme that emerges from all three sectors is that under optimal conditions, *effective* teams often reflect the cliché that the whole is greater than the sum of its parts.

Of particular relevance to our work is how changes in American industry are driving changes in education and training. Numerous studies and commissions have examined the skill requirements for tomorrow's entry level worker. O'Neil, Allred, and Baker (1992) reviewed five major studies on workforce readiness commissioned by federal, state, or private agencies. All studies identified interpersonal and teamwork skills to be *essential* skills.

The private sector's emphasis on teamwork has gained momentum as global competitive pressures have forced companies to alter management practices. Downsizing, reorganizations, and other structural changes in the workplace have resulted in companies placing greater responsibility on their workforce. A prevailing belief is that teams offer the potential to dramatically improve a company's competitiveness (Cannon-Bowers, Oser, & Flanagan, 1992). Whether employees participate in teams as adjuncts to their regular job (e.g., quality-circle teams) or participate in teams full-time (e.g., negotiating teams), the implication is clear: Increasingly, employees are being required to be part of teams. Given the importance of teams in the American workforce, one of our goals is to develop feasible measures of teamwork processes of high school students. Educators and employers can then use these measures to help them focus on education and training efforts.

A Taxonomy of Team Processes

Morgan, Salas, and Glickman (1993) provide insight into the nature of teams. In their model of team development, Morgan et al. (1993) postulate two tracks of team process, a taskwork track and a teamwork track. The taskwork track accounts for specific activities unique to the task. Taskwork team skills influence how well a team performs on a particular task (e.g., whether or not a team of negotiators reaches an agreement with the other party). Taskwork skills are domain-dependent, task-related activities. The teamwork track or team workskills influence how effective an individual member will be as part of a team and are domain-independent team skills. Team workskills encompass skills such as adaptability, coordination, cooperation, and communication. Effective teams develop competence along both tracks. Members of effective teams possess basic skills required for the task and know how to coordinate their activities, communicate with each other, and respond effectively to changing conditions.

We have drawn on the work of Morgan et al. (1993), Salas, Dickinson, Converse, and Tannenbaum (1992), Burke, Volpe, Cannon-Bowers, and Salas (1993), and others (O'Neil, Baker, & Kazlauskas, 1992; Webb, 1993; Webb & Palincsar, in press) to aid our development of teamwork process measures. From the taxonomy of teamwork skills identified by Burke et al. (1993), we have adopted the following six categories: (a) adaptability—recognizing problems and responding appropriately, (b) coordination—organizing team activities to complete a task on time, (c) decision making—using available information to make decisions, (d) interpersonal—interacting cooperatively with other team members, (e) leadership—providing direction for the team, and (f) communication—the overall exchange of clear and accurate information. In the following discussion we first define and then elaborate on each process with examples from the teamwork literature.

Adaptability is the process by which a team is able to monitor the source and nature of problems through an awareness of team activities and factors bearing on the task. Adaptive teams use this information to adjust to situational demands by using compensatory and feedback behaviors.

An important facet of adaptability is the detection and correction of problems. Sometimes this detection process is labeled situational awareness.

Members cross-check each other's performance, provide backup when needed, and freely provide feedback to and accept feedback from each other (McIntyre & Salas, in press). For example, Oser, McCallum, Salas, and Morgan (1989) observed moderate correlations between various team behaviors and team effectiveness as measured by a team simulation score. Oser et al. (1989) studied the performance of 13 Navy fire-control crews and found that the top three (more effective) teams, compared to bottom three (less effective) teams, differed across a range of behaviors. With respect to problem detection and correction, members of more effective teams (a) helped others who were having difficulty with a task ($r = .67, p < .05$), (b) assisted others when they had difficult tasks to perform ($r = .49, p < .05$), (c) suggested to others to recheck their work to find their mistakes ($r = .54, p < .05$), and (d) provided suggestions to others on the best way to find an error ($r = .49, p < .05$).

Coordination is the process by which team resources, activities, and responses are organized to ensure that tasks are integrated, synchronized, and completed within established temporal constraints. Our view of coordination is that it primarily involves task accomplishment rather than interpersonal harmony.

One area where coordination has received much attention is in aircrew management. Poor team coordination has been cited as a cause in aircraft disasters (Foushee, 1984) while good team coordination has been associated with better training performance (Brannick, Roach, & Salas, 1993; Kanki, Lozito, & Foushee, 1989a). For example, Brannick et al. (1993) had 52 dyads participate in a low-fidelity (personal computer) flight simulator. Participants were college students participating for extra class credit. Most participants (76%) did not have any personal computer flight simulator experience. The teams' mission was to shoot down as many enemy planes as possible within 30 minutes. Each member had control over different parts of the simulator (e.g., one member would control the piloting and the other would control the fire-control system). Interdependency was built into the task such that the enemy plane could be shot down only with both members working together. With respect to coordination, Brannick et al. (1993) found significant correlations between team coordination and the outcome measure of team performance (as measured by the number of radar "locks" by the enemy plane; $r = .29, p < .05$). Brannick et al. defined coordination as properly sequenced behavior and the

exchange of useful information. Oser et al. (1989) observed similar results of effective information management. Members of effective teams, compared to less effective teams, showed more coordinated gathering of information (r = .50, $p < .05$).

Interestingly, Brannick et al. (1993) also found that experience with computer flight simulators was significantly correlated with coordination (r = .31, $p < .05$), as well as with (a) communicating about escaping the enemy plane (r = -.34, $p < .05$), and (b) communicating about the meaning of the simulator display (r = -.58, $p < .05$). It is interesting that the latter two relationships are negative. One interpretation of their finding is that familiarity of the situation contributes to how team members coordinate their activities. Team members share an understanding about certain tactical and operational elements of the simulator, which reduces the need to discuss those elements. Such shared mental models have been observed in aircrews familiar with each other compared to aircrews that were working together for the first time (Foushee, Lauber, Baetge, & Acomb, 1986). Foushee et al. (1986) speculated that familiarity aided team performance as crew members were familiar with each other's behavioral and communication styles. This familiarity helped crew members anticipate and respond to each other's needs and actions. Similarly, Kanki, Lozito, and Foushee (1989b) observed that predictable and homogeneous communication patterns distinguished low-error from high-error aircrews using high-fidelity flight simulators. Low-error aircrews exhibited uniform communication patterns with respect to speaking and responding to each other. Conversely, high-error aircrews exhibited widely varying patterns. In effect, these aircrews lacked a standard way of communicating with each other, in contrast to the low-error aircrews.

The nature of these kinds of shared mental models has been the focus of recent models of team performance (Cannon-Bowers, Salas, & Converse, 1993; Rouse, Cannon-Bowers, & Salas, 1992) and is discussed in greater detail in the next section.

Decision making is the ability to integrate information, use logical and sound judgments, identify possible alternatives, select the best solution, and evaluate the consequences.

Shared mental models provide a useful perspective on team decision making (Cannon-Bowers et al., 1993; Rouse et al., 1992). A mental model can be thought of as a person's conception of a system (e.g., a negotiation task). Mental models help people describe the purpose and form of the system, help them explain the system's function and what it is doing, and help them predict what the system will do in the future (Rouse et al., 1992). In terms of team performance, Cannon-Bowers et al. (1993) suggest that four kinds of mental models are pertinent to team performance: (a) models of the task to be performed; (b) models of the operating characteristics of the task-related equipment; (c) models of the roles, responsibilities, and interdependencies of each team member, and of how information flows within the team; and (d) models of each member's skills, knowledge, abilities, and behavior patterns. A shared mental model represents an overlap between individual members' mental models.

Rouse et al. (1992) make several predictions about teams that possess shared mental models. Two are relevant to decision making. First, Rouse et al. (1992) predict that teams with shared mental models will require less overt planning time for good performance. Essentially, if everyone knows what to do, then they don't need to discuss it. Second, teams with shared mental models will engage in less overt communication but maintain performance. In this case, team members are competent and proficient in what they do and how they interface with each other. Overt requests for information will decrease because team members are able to predict the needs and actions of others. What the shared mental model perspective suggests is that effective decision making is inextricably tied to group coordination. Presumably, the quality of decision making covaries with the quality of coordination. The more coordinated the group, the better the decision-making process and vice-versa.

These predictions have an important implications for team decision making. Teams with shared mental models will converge on a decision faster because everyone has a comparable understanding of the task demands. Team members capitalize on their shared understanding to minimize nonessential, overt communication. Everyone knows who is responsible for what and who to communicate with. With a shared understanding members know whom to provide information to and when to provide it, and the recipient of information knows that the information is relevant and timely.

Support for this view is observed in Brannick et al.'s (1993) study discussed earlier. With respect to time, Brannick et al. observed significant correlations between task time and quality of performance as measured by (a) observers' holistic ratings (r = -.48, p < .05) and (b) number of locks by the enemy aircraft (r = .53, p < .05). Teams that took longer to shoot down the enemy plane were (a) rated as performing poorer on the simulation and (b) had a higher number of radar locks on their plane by the enemy. And as discussed earlier, Brannick et al. (1993) also found significant negative correlations between experience and two communication frequency measures, and found negative correlations (although these correlations were nonsignificant) between experience and five of the remaining six indicators. Further, Brannick et al. (1993) found negative correlations between all communication acts and the outcome measures, suggesting that the more team members "talked it up," the more their task performance suffered. The research conducted by Lahey and Slough (1982) suggests this interpretation in that instructors who graded team training exercises gave lower grades to military teams doing excessive talking.

These negative correlations between communication frequency and team performance is puzzling, given the wealth of findings pointing toward the importance of communicating on teamwork (Foushee et al., 1986; Kanki et al., 1989b; McIntyre & Salas, in press). What may be occurring is that poorly performing teams are "talking it up" in an attempt to improve their condition.

Interpersonal skill is the ability to improve the quality of team member interactions through the resolution of team members' dissent, or the use of cooperative behaviors.

Team reinforcing behaviors have been found to be related to effective team performance (Oser et al., 1989). Interpersonal processes are important not so much to minimize intergroup friction, but more so to foster team interdependence. That is, cooperative behavior reflects a commitment to team performance (Mullen & Copper, 1994). Cooperative behavior reflects a belief that each member is critical to the overall success of the team, and helping others helps the team. Members of effective teams value team performance over individual performance and view themselves as part of a team and not simply individuals working together (McIntyre & Salas, in press).

Oser et al. (1989) found significant relationships between interpersonal behaviors and team performance. Members of more effective teams tended to (a) make positive, motivating statements ($r = .54, p < .05$), (b) praise others for a good job ($r = .59, p < .05$), and (c) thank others for catching a mistake ($r = .60, p < .05$). In addition, Oser et al. (1989) observed negative correlations when team members made negative statements directed at the team or the training ($r = -.70$), or when a member raised his voice when correcting another member ($r = -.60, p < .05$). Brannick et al. (1993) found a similar pattern of results. In their study, Brannick et al. (1993) found significant relationships between (a) the amount of suggestions given and team performance ($r = .29, p < .05$), and (b) cooperative behavior and team performance ($r = .29, p < .05$).

Leadership is the ability to direct and coordinate the activities of other team members, assess team performance, assign tasks, plan and organize, and establish a positive atmosphere.

In their summary of "lessons learned" from their teamwork research, McIntyre and Salas (in press) suggest that team leadership style plays a crucial role in the functioning of a team. In particular, good team leaders exhibit the kinds of behaviors that help team performance in general: the ability to adapt to changing conditions, exchange information, provide and accept feedback, and provide and accept help. A good team leader is a model of teamwork that other team members can emulate.

The Oser et al. (1989) study described earlier provides support to McIntyre and Salas' (in press) analysis that good team leaders reflect good team processes. Oser et al. (1989) observed that leaders in more effective teams, compared to leaders in less effective teams, initiated far more of the critical behaviors (i.e., error identification and resolution, coordinating information gathering, and team encouragement). In their review of the teamwork literature, Macpherson and Perez (1992) concluded that during training, a team leader should be encouraged to solicit recommendations from team members, analyze and comment on those recommendations, and then communicate his or her decisions to the team.

One crucial aspect of good team leadership is the willingness to accept feedback from subordinates. A good team leader establishes an environment where there is a free and bi-directional flow of information between the leader

and members. Leaders who constrain this flow of information—by virtue of their leadership style, rank, or personality—impede team performance. Team members in this kind of environment are often inhibited from giving feedback or backup. Foushee (1984) reports that copilots in these kinds of environments often hesitate to voice concerns, even in potentially dangerous situations. For example, in 1979 a commuter plane crashed because the copilot failed to assume command after the pilot became incapacitated. The captain was the company vice-president, had a gruff personality, and was noticeably upset on the day of the crash. The copilot was recently hired and still on probation. Foushee (1984) speculates that had the copilot not been intimidated, he would have assumed control and possibly averted the disaster.

Communication is the process by which information is clearly and accurately exchanged between two or more team members in the prescribed manner and by using proper terminology, and the ability to clarify or acknowledge the receipt of information.

Perhaps the most powerful index of team performance is the extent and character with which team members interact with each other. Communication underlies every team process discussed above. As a process, effective communication couples team members' expectations, actions, responses, and feedback behaviors. Communication facilitates the transmission and reception of support behavior, and the detection and correction of error conditions (McIntyre & Salas, in press; Oser et al., 1989), helps team members synchronizes their activities (Foushee, 1984; Kanki et al., 1989a, 1989b; McIntyre & Salas, in press; Mullen & Copper, 1994), influences the quality of decision making (Brannick et al., 1993; Cannon-Bowers et al., 1993; Rouse et al., 1992), influences the character of team cohesion (McIntyre & Salas, in press; Oser et al., 1989), and establishes operational norms between members (Foushee et al., 1986; McIntyre & Salas, in press; Mullen & Copper, 1994). It should be noted that excessive communication is counterproductive (e.g., Lahey & Slough, 1982).

Team Processes in a Negotiation Context

The negotiation context within which we frame our teamwork processes is the mixed-motive interdependence paradigm (Bazerman, 1990; Carnevale & Pruitt, 1992; O'Neil et al., 1994). Briefly, this paradigm incorporates two

dimensions of negotiation styles, distributive and integrative. Distributive negotiation reflects a view that the issues under negotiation are equally valued by both parties; conceding on an issue necessarily means a loss. Such a view leads to a negotiating strategy of attempting to gain as much as possible across all issues—a zero-sum/win-lose perspective. Integrative negotiation reflects a view that the issues under negotiation have differing values for both parties. A concession on an issue does not necessarily mean a loss. Rather, conceding on an issue of low importance may result in gaining on an issue of high importance. This leads to a negotiation strategy of seeking ways in which both parties can benefit. Integrative negotiation reflects a variable-sum/win-win view of the situation. Expert negotiators adopt a integrative negotiation style. The mixed-motive interdependence paradigm has the potential to elicit many of the team processes defined above. In the following discussion we analyze each team process in the context of this negotiation scenario, outlining the kinds of behaviors we expect to emerge.

Adaptability. In general, a team's adaptive capability affects the nature of the team's response to a given situation. Are team members able to detect problems as they arise and, once detected, respond effectively to resolve the problems? Do team members exhibit innovative and flexible responses to situations?

Applying our definition of adaptability to the negotiation scenario suggests two kinds of outcomes. First, members exhibiting adaptive behavior should show more willingness to be integrative in their responses. For example, flexible team members would recognize that not all issues are equally important and would thus carry out negotiations accordingly. Issues of low importance could be traded away for gains on issues of high importance. Conversely, members showing little adaptability might not recognize this situation and would hold firm across all issues. We expect integrative behavior to manifest itself as questions or statements that try to uncover the other party's priorities and values.

A second outcome of adaptive behavior is the use of compensatory feedback. That is, members provide information to each other regarding the current situation. We would expect compensatory behavior to manifest itself as members agreeing, disagreeing, asking for ideas, or suggesting possible courses of action.

Coordination. In general, a team's coordination capability affects how that team organizes its resources, activities, and responses. Teams with high coordination will carry out a task that is integrated, synchronized, and completed on time.

Coordination in the context of a negotiation scenario suggests that sequencing would be important. We believe that members of coordinated teams will show a propensity to sequence offers in an attempt to tease out the other team's values and priorities. Conversely, members of less coordinated teams will show a tendency to propose offers that will vary widely from round to round. In addition to sequencing, we also expect that highly coordinated teams will be cognizant of time constraints and communicate this aspect to other members when appropriate.

Decision making. A team's decision-making capability affects its ability to capitalize on available information. Effective teams use information about their current situation to help them evaluate the worthiness of potential courses of action.

In the context of a negotiation scenario, we expect to see several kinds of decision-making patterns contingent on how well the teams understand the negotiation situation. First, for teams that enter the negotiation simulation with an existing understanding of how to negotiate, we expect that these teams will quickly reach a resolution and engage in little debate over what should be the proper strategy. In effect, these teams have shared mental models of the negotiation situation, and this understanding helps the team reach an agreement.

For teams with less of an understanding (e.g., novices), one of two things could happen. First, these teams could come to an understanding by reasoned discussion. Such teams would pursue a course of action after discussing alternatives and potential consequences. Thus, we would expect members to provide specific reasons for a particular position, and that these reasons reflect an integration of information about the specific negotiation situation. For example, a member might suggest going lower on an issue because that issue is important to the other party. Alternatively, teams with less of an understanding could simply engage in help-seeking behavior. That is,

communication between members would be dominated by appeals for ideas about what to offer, what tactic to take, and the like.

Interpersonal. In general, a team's interpersonal capability affects how well team members work cooperatively. Do team members encourage each other to work together? Do team members help resolve team member dissent?

In terms of our negotiation scenario, we would expect teams with a high interpersonal dimension to encourage member participation, help seeking, and help giving. In addition, we would expect members to freely exchange compliments.

Leadership. In general, a team's leadership capability affects its ability to provide direction for the team. To what extent does a member coordinate the activities of other members? Does the team engage in planning and organization that reflect appropriate priorities?

In our negotiation scenario we expect that teams or team members high in leadership will engage in communication that provides direction and sets priorities. We would expect a member strong in leadership to place the current negotiation situation in context of the team goal. For example, such a member would remind other members of the team's priorities, thereby aligning task engagement with task goals. We also suspect that strong leadership would manifest itself in directives. In this case, communication would take the form of directing others to do something. Finally, we believe that good leadership will be reflected in a leader who is receptive to input from other members.

We believe that our earlier efforts using an individual-level negotiation scenario (O'Neil et al., 1994) provide a useful context for studying team-level processes. In the next section we first discuss current approaches to measuring teamwork processes and their limitations. We then describe how we address those limitations in our research.

Measuring Teamwork Processes

Our work focuses on assessing team processes that emerge during the negotiating of a contract. We are interested in the nature of the interaction between team members and how that interaction impacts team performance. Yet a critical measurement issue remains unresolved: How do we assess

teamwork processes such that the measurement technique is reliable, valid and timely?

Our previous work on using computer simulation suggests that our approach is feasible, reliable, and valid when measuring individual negotiation skills (O'Neil, Allred, & Dennis, 1992; O'Neil et al., 1994). Our simulation technique reliably discriminated between experts and novices, providing strong support for the validity of our approach. Our findings persisted across different negotiation contexts and populations (i.e., high school students negotiating for a job at a movie theater, law students negotiating for a job with a law firm).

However, our preliminary attempts at using teams in the same simulated negotiation context were inconclusive (O'Neil et al., 1994). In O'Neil et al. (1994, Study 2), 3-person teams were compared to 2-person teams. The negotiation scenario was identical to that which individuals engaged in. The primary difference between the scenarios was that the team scenario required the team members to agree verbally on a course of action. Then, one team member would communicate that decision to the computer.

Although O'Neil et al. (1994) found nonsignificant effects on one measure of performance (final counteroffer), the results were in the predicted direction (3-person teams performing better than 2-person teams). On the measure of quality of performance (integrative vs. distributive), O'Neil et al. found no significant differences. Finally, in terms of frequency of agreement, O'Neil et al. did find significant effects. Three-person teams tended to reach agreement more often than 2-person teams. While the measures used in O'Neil et al. (1994) captured team outcomes, they did not capture the underlying teamwork processes. Thus, the focus of our current work is to develop methods for measuring teamwork processes.

Existing approaches to measuring teamwork processes rely almost exclusively on observational methods (Baker & Salas, 1992). For example, behavioral checklists (e.g., Oser et al., 1989), videotaped and audiotaped observation (e.g., Brannick et al., 1993), and analysis of think-aloud protocols are the most common techniques to measure teamwork processes. These methods are labor intensive and time-consuming. Observations must be transcribed, coded, and analyzed post hoc. Such techniques offer no

opportunity for rapid analysis and reporting of team performance. From an assessment perspective, these methods are unappealing because of the lag between test administration and reporting of test results. Further, these methods are neither practical nor cost-effective in large-scale test settings.

Our approach to addressing these limitations is to expand our computer-based negotiation simulation to a new context (union-management negotiation of a contract) and to incorporate real-time measures of teamwork processes. To achieve this, we broadened the scope of the computer-based negotiation simulation in the following way. Individuals were assigned to their own computers and collaborated with team members through a custom-developed computer conferencing system (e.g., McCarthy, Miles, Monk, Harrison, Dix, & Wright, 1993). Note that our initial system implemented the sending of both predefined messages and free-form messages; more typical conferencing systems allow for sending of typed-in, free-form messages only. This approach of linking team members via a network differed from our preliminary investigation of teams (see Study 2 of O'Neil et al., 1994 for differences). In that study, O'Neil et al. (1994) physically grouped one team with one computer (e.g., three participants sharing one computer). Discussion took place face-to-face but was unrecorded. In the present study, each individual operated his or her own computer and interacted with other team members by sending messages.

Our final technique for capturing teamwork processes is to use a pre-defined taxonomy of teamwork skills discussed earlier and categorize the expected communication acts team members would engage in. We have developed a priori a set of "canned" messages which members can send to each other. Further, we have categorized these messages as belonging to one of the five teamwork processes (adaptability, coordination, decision making, interpersonal, and leadership). This taxonomy of teamwork is domain independent and independent of scenarios. By tracking the messages selected and sent (and hence, by definition, the teamwork process category) we get a good index of the kinds teamwork processes emerging. We assume that each message in a category is as important as any other message, and thus all messages are equally weighed. Using those techniques provides us with a real-time teamwork assessment system. We can administer, score and interpret in real time. The Methods section covers the messages and their associated categories in greater detail.

Pilot Studies

Two pilot studies were conducted to assess the feasibility of our approach. The first pilot study represented our initial attempt at assessing the functionaiity of the computer system and messages. We were interested in feedback from users regarding usage of the system, messages, and task performance. The second pilot study reflected several major revisions to the system based on the first pilot study. The two pilot studies are described in greater detail below.

Pilot Study 1

Participants. The first pilot study used three groups of adults. Participants were drawn from available graduate, undergraduate, and other nonstudent adults in our laboratory. Two groups were run formally, where participants worked as a team under controlled conditions. In these groups, the programmer of the computer system participated and assumed the role of an advisory member. The third group was run informally, where participants provided comments about the system as they carried out the negotiation task.

Negotiation task. For our pilot study we created a scenario where participants collaborated in 3-person teams. Each team consisted of one leader and two advisory members. The team assumed the role of representing a union, and the team's responsibility was to negotiate a contract with a fictitious (i.e., simulated) management team. The issues under negotiation were wages, health and welfare, and pension. The simulated management team was programmed to concede on its most important issue when the union (i.e., participant) team did likewise (O'Neil et al., 1994). Thus, the simulated management team mirrored the negotiating behavior of the participants' team. The team outcome measures, based on previous research (O'Neil et al., 1994), were (a) whether agreement was reached and (b) whether the agreement was integrative or distributive.

Messages. In order to capture team processes in real time, we developed a set of messages for each teamwork category (e.g., interpersonal skills) identified above. Traditionally, measurement of teamwork skills is done using human judges either to rate observations (live or videotaped) of a team interacting, or to rate transcripts of team members' think-aloud protocols. In

our case, we developed messages a priori to represent team processes. Our intent was to have team members use these messages to communicate with each other regarding the negotiation. For our feasibility study, we included a variety of message types that reflected good and poor team skills. The following list gives examples for each category: (a) adaptability—"We should try something different"; (b) communication—"I don't understand, please explain"; (c) coordination—"We need to hurry up"; (d) decision making—"We might want to give a lot on pension"; (e) interpersonal—"I am interested in hearing from you on this"; (f) leadership—"Let's place an offer now"; and (g) motivation—"Our objective is to maximize our interests."

Computer system. The computer platform we used was the Macintosh (1993), and the software was developed with HyperCard 2.2 (1993). We used the built-in networking capabilities of the operating system (System 7, 1992) and HyperCard (1993) to implement a rudimentary client-server system. We designed the computer system to enable members to communicate with each other via a common message blackboard. Messages were posted as they were dispatched by members. All members had read and write access to the blackboard. To send a message, participants first selected one of the message categories. A list of predefined messages for that category appeared, and participants either chose a predefined message or entered their own message. The computer system recorded the number of messages (both predefined and self-generated) sent from each category.

The message sending capability was organized around teamwork category. To send a message, participants first clicked on a button representing one of the teamwork categories. Then, a window opened that presented a list of predefined messages for that category as well as an option where the participant could type in his or her own message. If the participant chose to send a predefined message, he or she simply clicked on the message and the message was dispatched. Alternatively, the participant could type in a message. Participants were also provided with a paper listing of all the messages sorted by teamwork category.

Results. For the first group, the maximum number of rounds was set to 12. (We define one round to consist of an offer from the union team and a counteroffer from management.) The total number of messages sent was 231, and no agreement was reached. The simulation ended after the allotted 12

rounds and ran for 100 minutes. For the second group, the maximum number of rounds was set to 10. The total number of messages sent was 124, and agreement was reached on round 8 after 82 minutes. For the third group, the maximum number of rounds was set to 8. The total number of messages sent was 49, and agreement was reached on round 7 after 70 minutes. These results of the first pilot study point to strengths and limitations of our initial approach. These findings are outlined below.

All groups participated with sustained interest and effort. Despite participants' knowledge that they were negotiating with a simulated management team, all groups approached the task with concerted effort. Participants reported that the task was interesting and that they were genuinely trying to reach an agreement.

A review of the message transcripts also suggests a consistent pattern of communication. In general, communication repeatedly took the form of a 3-stage process. In the first stage, someone (usually the leader) would suggest a specific offer. The second stage was characterized by a discussion of the pros and cons of that offer, how the offer might impact the team, and potential actions the management team might take in response to the offer. During this stage alternative offers were suggested by all team members. The last stage was characterized by someone (usually the leader) making a suggestion to wrap up the discussion and make a decision. The leaders of all groups sought consensus before sending the offer to management. There was no evidence of a leader acting independently or dictatorially.

The networked computer simulation clearly evoked a strong desire to communicate. Participants wanted to communicate immediately, and using the enter-own-message facility was the most efficient way to do it. In the two formal groups, team members started using the predefined messages in earnest, but quickly resorted to the enter-own-message facility. In the third group, all members immediately resorted to and relied on the enter-own-message facility.

All three groups avoided using the predefined messages primarily because they had difficulty interpreting the message categories. Participants uniformly reported that the message categories were unclear, ambiguous, and cumbersome to use. The presence of message categories impaired rather than

facilitated communication. Generating a message was simply easier than searching for an appropriate one. A review of the transcripts suggests the ease of entering messages was a major reason for not using the predefined categories and messages. However, for many of the self-generated messages, the substance of those messages mapped reasonably well onto our predefined message categories.

Pilot Study 2

The results of the first pilot study provided insight regarding our initial approach and informed us about needed revisions. First, although the presence of the enter-own-message facility clearly enhanced communication and was the preferred method of communication, the number of overlaps between the self-generated messages and the predefined messages suggested that we were able to capture the substance of what participants wanted to communicate. Second, the finding of a stable communication pattern suggested a different way of organizing the messages. Rather than grouping messages by teamwork categories, this finding suggested grouping messages by communication function. We were also able with this scheme to avoid teaching what the categories were and how to use them.

Incorporating these findings in the second pilot study required two major changes to the system. The first change involved eliminating the enter-own-message facility. Our intent was to capture team processes in real time; maximizing ease of communication was of secondary importance. Results from the first pilot study suggested that our predefined messages were able to capture what participants wanted to say. In addition, we refined our message set to reflect what pilot study participants had typed in.

The second change was made to the way the messages were organized for participants. In the first pilot study the organization was done on-screen (i.e., having one button per teamwork category). In the second pilot study we shifted the organization from the computer screen to a paper handout. The handout listed all the messages and was organized functionally. For example, messages that were commonly used were grouped together under the heading "Quick Responses." Each message on the handout corresponded to a button on the screen. To send a message, participants clicked on the button that corresponded to the desired message on their handout.

Participants and negotiation task. Six adults (two groups) were drawn from available undergraduates. Participants took part in the same negotiation task as participants in the first pilot study.

Messages. For the first group, we revised the message set from the first pilot study, incorporating new messages based on what participants typed in. In addition, we generated additional messages that we believed to be consistent with our definitions of team categories. Participants received a handout with messages divided into eight areas. The areas were (a) quick responses, (b) input from other members, (c) negotiating priorities, (d) entering offers, (e) discussing offers, (f) wages, (g) health and welfare, and (h) pension. The handout listed 86 messages.

For the second group, we used feedback from the first group to reorganize the handout. We included additional messages that they suggested, as well as new messages we generated. For this group, we partitioned the handout into 11 sections. These sections were (a) a flow-chart depicting the 3-stage process we observed during the first pilot study, (b) quick responses, (c) seeking assistance, (d) team spirit, (e) entering offers, (f) adjusting offers, (g) reasons for going higher/lower on each issue, (h) time concerns, (i) sending offers, (j) awareness of our team's priorities, and (k) awareness of the management team's performance.

Results. For the first group, the maximum number of negotiation rounds was set to 8. The total number of messages sent was 270, and agreement was reached on round 8 after 60 minutes. For the second group, the maximum number of rounds was also set to 8. The total number of messages sent was 193, and agreement was reached on round 6 after 55 minutes.

Postsession interviews with groups revealed that members felt the system was usable. Members said they were able to communicate with each other adequately (although all participants wanted the capability to enter their own messages). Participants found the message set to be, on the whole, adequate to carry out the negotiation task.

Hypotheses

Drawing on the taxonomy of teamwork processes outlined by Burke et al. (1993) and our analyses of these processes in the context of the mixed-motive interdependence negotiation, the following hypotheses are suggested.

Hypothesis 1: Team processes will be positively associated with team performance and time.

We expect that teams that exhibit higher levels of the team processes (adaptability, coordination, decision making, interpersonal, and leadership) will perform better on the negotiation simulation. Performance is defined in our scenario in four ways: (a) final counteroffer, (b) frequency of agreement, (c) type of agreement (integrated vs. distributed), and (d) time. The widespread finding that effective teams engage in these kinds of processes leads us to believe that team performance on our negotiation simulation will reflect similar patterns.

Hypothesis 2: Team performance will be negatively associated with time-to-agreement.

As suggested by the results of Brannick et al. (1993) and the work on shared mental models (Cannon-Bowers et al., 1993; Rouse et al., 1992), we expect time to be sensitive to team decision making. Specifically, we expect that teams engaging in more communication will take longer to reach an agreement.

Hypothesis 3: Team performance will be negatively related to the degree of fixed-pie bias.

Our prior results (O'Neil et al., 1994) indicate that good performers (experts) displayed less fixed-pie bias.

Hypothesis 4: More self-regulatory activity will result in higher team performance.

Our prior results (O'Neil et al., 1994) suggested that more self-regulating activity and less worry distinguished experts from novices. Thus, we expect that higher self-regulating activity would lead to higher team processes and, in turn, better team outcomes.

Methods

Participants

Eighty-one participants (34 male, 47 female) participated in this study. All participants were drawn from a high school located in southern California. One teacher provided four classes of students. Students participated as part of that day's class activity. UCLA and USC procedures for protection of human subjects were followed (e.g. parental approval, informed consent).

The overall ethnic composition of the participants was 29 White/Anglos, 3 Black/African Americans, 4 Hispanic/Latinos, 38 Asians, and 7 Middle Eastern/Persians. Participants' ages ranged from 14 to 18 years old (60 sophomores, 21 seniors). Participants came from three 10th-grade classes (18, 18, and 24 participants respectively) and one 12th-grade class (21 participants). The content of all classes was American history.

Participants drawn from these intact classes covered a range of academic standing, ethnic, and gender compositions. The first class was of normal academic standing (sophomores) and was composed primarily of Asian, Middle Eastern/Persian, and female students (2 Whites, 2 African Americans, 1 Hispanic/Latino, 9 Asians, 4 Middle Eastern/Persians; 6 males, 12 females). The second class was a 10th-grade "resource class" (each student had an individual educational plan). This class was composed primarily of White students (11 Whites, 2 Hispanic/Latinos, 3 Asians, 2 Middle Eastern/Persians; 9 males, 9 females). The third class was of normal academic standing (seniors) and composed primarily of White students (14 Whites, 1 Hispanic/Latino, 5 Asians, 1 Middle Eastern; 11 males, 10 females). The fourth class was a 10th-grade Advanced Placement class composed primarily of Asian and female students (2 Whites, 1 African American, 21 Asians; 8 males, 16 females).

Negotiation Scenario

The negotiation aspect of the task followed the format established in previous studies (e.g., O'Neil et al., 1994). As discussed earlier, the present study extended the negotiation task by adding a teamwork dimension. Table 1 presents the general domain specifications embedded in the software.

Table 1

Domain Specifications Embedded in the Software

General domain specification	Specific example
Scenario	Role play a contract negotiation by exchanging proposals in mixed-motive context
Players	One or more students and one manager (computer software)
Student	Either expert or novice, individual or team
Manager	Computer software (Carnevale & Conlon, 1988; O'Neil, Allred, & Dennis, 1992)
Priorities	Offsetting
Moves	Reciprocal
Rounds	Offer from student and counteroffer from manager
Subcompetencies	Propose options; make reasonable compromises
Negotiation issues	Three in number (e.g., salary) with offsetting priorities
Negotiation measures	Agreement (yes/no), type of agreement (distributive vs. integrative), final counteroffer
Cognitive processes (domain-dependent)	Fixed-pie bias
Cognitive processes (domain-independent)	Metacognitive skills
Affective processes (domain-independent)	Effort, Worry

The scenario presented to participants was that of a union-management labor negotiation situation. The ecological validity of our scenario was facilitated by information from the union and management leadership of the Southern California Airconditioning and Refrigeration Industry. Values for the negotiation issues were used from the industry's *Master Agreement* (Southern California Airconditioning and Refrigeration Industry, 1990). Our messages were also reviewed by the industry and union leadership (see Table 2). In general, they felt that we had captured the formal negotiation process but that the informal process was not well captured (e.g., business conducted on the golf course, the use negative interpersonal remarks).

Table 2

Team Work Skills

Adaptability	
– Recognizing problems and responding appropriately	*If we give on wages, they might give on pension.*
Coordination	
– Organizing team activities to complete a task on time	*We need to hurry to complete this round.*
Decision making	
– Using available information to make decisions	*We should go higher on health and welfare because it's their second priority.*
Interpersonal	
– Interacting cooperatively with other team members	*We are doing a great job.*
Leadership	
– Providing direction for the team	*Send the offer.*
Communication	
– Information is clearly and accurately exchanged between team members	*The total of messages minus "I sent the wrong message."*

Participants were informed that they were part of a 3-person team representing the union or management (in fact, all teams were representing the union; the computer simulated the management team). Participants were informed that their team's responsibility was to reach an agreement with the other side, and that the team should work together on what to offer the other team. Participants were informed they had eight rounds to complete the negotiations, and they were not told who their teammates were. Further, the negotiation scenario was not an interdependent task. It could be solved by a single student. Thus, in our scenario, the task is very similar to a collaborative learning math environment in K-12.

The negotiation was terminated under the following conditions. First, the team could accept the management team's offer at any time. Second, if the team sent an offer that was acceptable to the management team, then the management team would accept that offer. An offer that was integrative in nature (over 120 points) was accepted. The last way the negotiation could end is if no agreement was reached within the allotted 8 rounds. In that case, a final counteroffer was generated by the software.

Tables 3, 4 and 5 give examples of each case. Table 3 shows a group accepting the management team's offer at round 6. Table 4 shows the group's offer being accepted by the management team at round 8. Finally, Table 5 shows the group not reaching an agreement within 8 rounds.

Negotiation issues and priorities. The issues under negotiation were (a) wages, (b) health and welfare, and (c) pension. Participants were informed that their team's priorities were (in order of importance) wages, health and welfare, and pension.

To help participants gauge the value of the offers during negotiation, they were provided with an "issue chart." The issue chart was part of the computer display and hence always available. Participants were instructed to use these values to determine the value of their offer to the management team. Participants were instructed that they should try to negotiate an agreement that optimizes their total number of points. Table 6 shows the issue chart for the participants' team, and Table 7 shows the issue chart for the simulated

Table 3

Sample Negotiation With the Union Team Accepting the Management Team's Offer

Round	Management (computer) offer	Union (participant) offer
1	15-10-5	120-80-35
2	15-0-0	120-70-30
3	30-10-0	105-70-25
4	45-10-5	90-60-20
5	60-20-10	75-50-20
6	60-30-15	The union team accepts the management team's offer.

Note. The management (computer) team always makes the first offer.

Table 4

Sample Negotiation With the Management Team Accepting the Union Team's Offer

Round	Management (computer) offer	Union (participant) offer
1	15-10-0	105-60-35
2	15-20-5	90-60-35
3	15-20-10	90-50-25
4	45-30-10	60-50-25
5	75-30-20	75-40-25
6	45-40-15	60-40-15
7	45-40-20	60-40-20
8	The management team accepts the union team's offer.	

Table 5

Sample Negotiation With No Agreement Reached

Round	Management (computer) offer	Union (participant) offer
1	15-10-5	105-80-35
2	15-0-5	75-60-35
3	15-20-15	90-70-35
4	15-10-10	90-70-35
5	15-10-10	60-50-35
6	105-30-20	105-40-35
7	15-40-5	105-30-35
8	15-30-5	75-40-25

management team. Note that the issue priorities for the simulated management team are the reciprocal of the union team's priorities. Participants were not informed of the simulated management team's priorities.

The simulated management team (computer) was programmed to reflect priorities that were opposite to the union's team (see Appendix 1 for the computer algorithm). That is, the computer's highest priority was Pension followed by Health and Welfare and Wages (see Table 7). The computer's responses were programmed to reflect an integrative potential. If the union team gave on its value of least importance (Pension), the computer would give

Table 6

Issue Chart for the Union (Participant) Team

Wages	Health and Welfare	Pension
120	80	40
105	70	35
90	60	30
75	50	25
60	40	20
45	30	15
30	20	10
15	10	5
0	0	0

Table 7

Issue Chart for the Management (Computer) Team

Wages	Health and Welfare	Pension
0	0	0
5	10	15
10	20	30
15	30	45
20	40	60
25	50	75
30	60	90
35	70	105
40	80	120

on its issue of least importance (Wages), and the joint outcome would be maximized. Further, the computer was programmed to make offers that mirrored the union team's offers. If the union team gave on its most important issue (Wages), the computer would give on its issue of most importance (Pension). For the Health and Welfare issue (moderate priority to both the union and management team), the computer responded with a tit-for-tat strategy: A union concession would be mirrored by a equal concession by

the computer. In addition, the computer would accept any union offer that totaled 120 points or more (when computed from management's point of view). Thus, in some cases there was an implicit ceiling on the final counteroffer measured. As previously mentioned, the scenario was adopted from O'Neil et al. (1994). Table 8 shows the comparisons between the two versions.

Table 8

Comparisons Between the Current Software and That Used in O'Neil et al.'s (1994) Study

Item	Macintosh (current)	IBM (O'Neil et al., 1994)
User interface	Graphical user interface; user selected values and options via dialog boxes, pull-down menus, and clicking on buttons. Only black-and-white used.	Text display, user typed in offer values. Color used to emphasize information.
Offer processing	Accepting an offer done by computer and user.	Accepting an offer is incumbent on user. The computer NEVER accepts an offer.
No. of rounds	8	12
Raw data processing	Data is time-tagged and indexed with embedded comments. Redundant data archiving—data saved to text file and HyperCard stack. Program state saved as well. Raw data fully recoverable from HyperCard stack.	Single stream of data saved to a text file.
Development software	HyperCard 2.2	Turbo Pascal 4.0.
Networking	3-person network in client-server configuration. Use AppleEvents to pass data between computers.	No networking.
Instructions	Delivered as a computer tutorial with demonstrations.	Delivered by experimenters.
Issue chart	Displayed online with current offer highlighted.	Displayed online.
Job aid	Handout that listed available messages.	None.
Amount of help	Two experimenters plus classroom teacher. Help given only explaining how to operate computer and explain terms. No help given on how to reach an agreement or type of agreement.	Two experimenters. No classroom teacher. Otherwise, same.
Required computer skills	Typing helpful, mouse skills.	Typing helpful.
Post processing.	Raw data imported to relational database; data available for post-processing. Because data are indexed, able to selectively pull data for subsequent analysis.	None.
Message database	Messages tracked in relational database. Message revision history tracked; comments, pilot data usage tracked; interrater reliability tracked; development comments tracked.	Not applicable.

Computer Conferencing System

Three major components comprised the system: (a) predefined messages, (b) a handout that listed all messages, and (c) software to support the computer conferencing system. Each component is described below.

Messages. In order to capture team processes in real time, we developed a set of messages for the five teamwork categories. We developed a variety of messages *a priori*. Team members selected these messages to communicate with each other during the negotiation.

Fifty-one messages were provided to participants for use during the negotiation task. Fifty messages (10 messages/category) belonged to the five teamwork process categories discussed earlier (adaptability, coordination, decision making, interpersonal, and leadership). One message was provided to signal that a previously sent message was mistakenly sent by the participant. This message was excluded from the message categories. A sample message from each category is given below. Appendix 2 contains a complete list of messages and their categories.

Adaptability—recognizing problems and responding appropriately. A message belonging to this category is "What do you think, M1?" (M1 refers to Member 1 of the team.)

Coordination—organizing team activities to complete a task on time. A message belonging to this category is "We only have 5 rounds left."

Decision making—using available information make decisions. A message belonging to this category is "We should go higher on Wages because it's OUR 1st priority."

Interpersonal—interacting cooperatively with other team members. A message belonging to this category is "Help me out."

Leadership—providing direction for the team. A message belonging to this category is "Send the offer."

Communication—the overall activity of the teams. No messages were tied to this category; rather, communication represented the aggregate interaction between team members minus the number of error messages. Our definition of communication was that accurate

and timely messages were sent. Because all of the messages were selected and accurately sent via the network, we considered all of the team process messages were examples of communication.

Message handout. Participants received a paper handout with all 51 messages. The organization of the handout followed a 3-stage model of communication patterns that emerged during pilot testing. During the first stage, someone (usually the leader) would suggest a specific offer. The second stage was characterized by a discussion of the pros and cons of that offer, how the offer might impact the team, and potential actions the management team might take in response to the offer. During this stage alternative offers were suggested by all team members. The last stage was characterized by someone (usually the leader) making a suggestion to wrap up the discussion and make a decision. Figure 1 shows how the handout was partitioned. (See Appendix 3 for the actual handout.)

As Figure 1 shows, the top section provided general instructions on how to use the handout. This section also contained a flow chart that depicted the 3-stage process. The middle and bottom sections contained the actual messages. The middle section contained messages that were unique to each stage, and the bottom section contained messages that were common to all stages. (See also Appendix 3.)

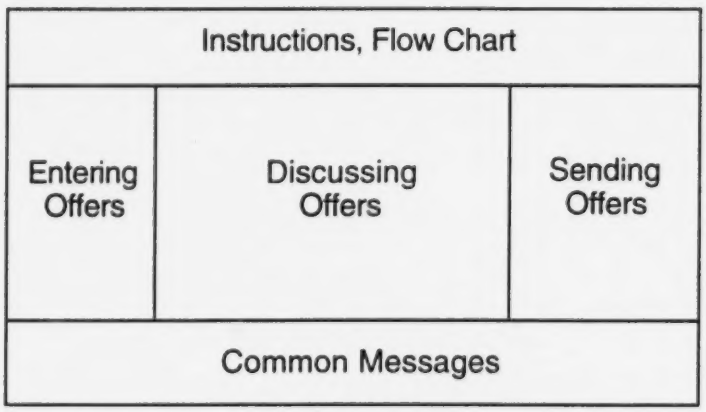

Figure 1. Layout of message handout used by participants during the negotiation task.

The "Discussing Offers" area was subdivided by function into five sections: (a) entering offers, (b) adjusting offers, (c) assessing performance, (d) keeping track of time, and (e) going higher/lower on the issues. Similarly, the "Common Messages" area was subdivided into two sections: (a) encouraging others and (b) quick responses.

Hardware/Software

The school's computer lab was used to run this study. The lab contained 18 computers, and we provided 6 additional computers. The 18 lab computers were Macintosh LC475s and the remaining computers were 5 PowerBooks and a SE/30. The 18 LC475s were networked with an Ethernet local-area-network (LAN), and the PowerBooks and SE/30 were networked with a LocalTalk LAN. The tutorial used to deliver task instructions was developed with MediaTracks (1990), and the software used in the negotiation task was developed with HyperCard 2.2 (1993). The computer operating system used was System 7 (1992), and each computer had at least 4MB of RAM and 40MB of hard disk space. The computer conferencing software tapped the built-in networking and interprocess communication capabilities of HyperCard 2.2 and System 7 to implement message sending between computers.

The user interface is shown in Figure 2. The display was partitioned into three major sections. The top-left section contained numbered message buttons. Each button corresponded to a particular message on participants' message handout. To send a message, participants clicked on a button and the message corresponding to that button would be sent to the other team members' computers. (See Appendix 3 for the message handout participants used to map messages to message numbers.) The lower left section of the screen displayed the messages sent by all the members. The messages were listed in the order sent. The right-hand section displayed the issue chart, current union and management offers, and (if the participant was the leader) buttons to send and accept offers. The team's current offer was selected by clicking on one of the issue values (highlighted numbers). The selection would appear on every team member's computer. Only the leader could select, send, or accept offers.

For certain messages, user input was required. These messages were handled by the use of dialogs that mostly required simple point-and-clicking.

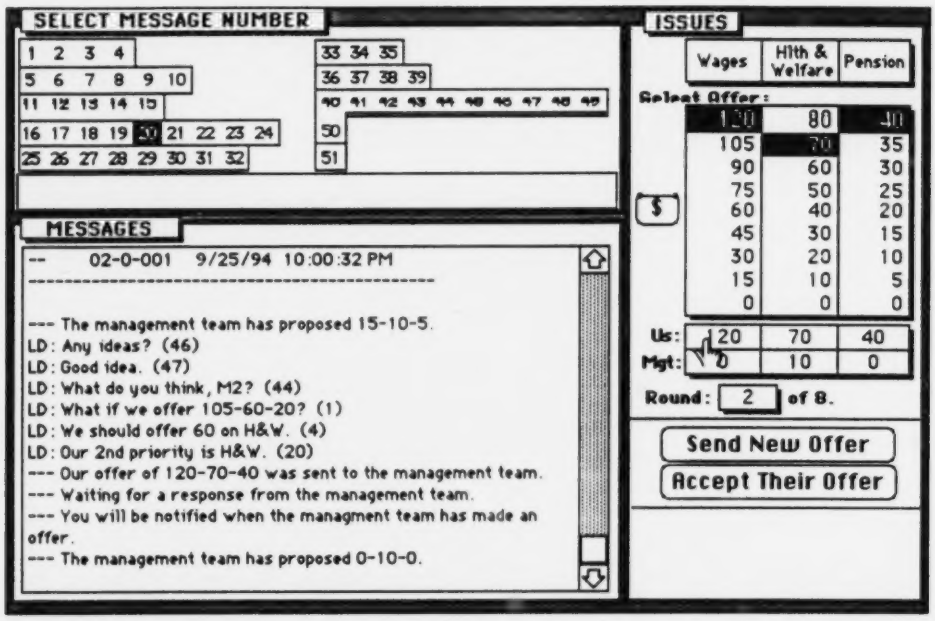
SELECT MESSAGE NUMBER
1 2 3 4
5 6 7 8 9 10
11 12 13 14 15
16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32
33 34 35
36 37 38 39
50
51
MESSAGES
-- 02-0-001 9/25/94 10:00:32 PM
--- The management team has proposed 15-10-5.
LD: Any ideas? (46)
LD: Good idea. (47)
LD: What do you think, M2? (44)
LD: What if we offer 105-60-20? (1)
LD: We should offer 60 on H&W. (4)
LD: Our 2nd priority is H&W. (20)
--- Our offer of 120-70-40 was sent to the management team.
--- Waiting for a response from the management team.
--- You will be notified when the managment team has made an offer.
--- The management team has proposed 0-10-0.
ISSUES
Wages
Hlth & Welfare
Pension
Select Offer:
$
120 80 40
105 70 35
90 60 30
75 50 25
60 40 20
45 30 15
30 20 10
15 10 5
0 0 0
Us: 120 70 40
Mgt: 0 10 0
Round: 2 of 8.
Send New Offer
Accept Their Offer

Figure 2. User interface for the team leader. Advisory team members' screens did not have the send and accept offer buttons. Note the three major sections (counter-clockwise from the top-left): message buttons, message display, and offer information.

For example, Figure 3 shows how the message "What if we offer X-Y-Z?" was handled. In this case, the participant simply clicks on the desired issue and selects the desired value.

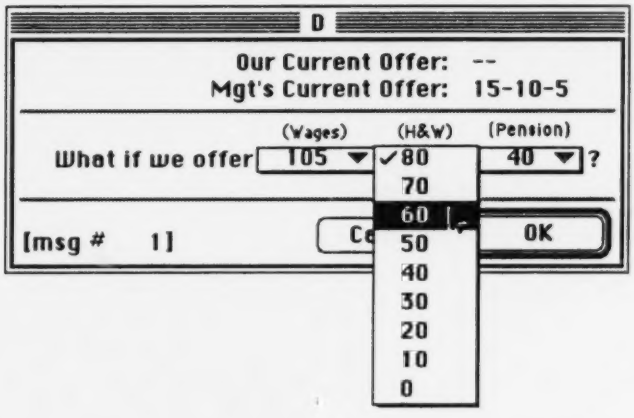

Figure 3. Message requiring user input: selecting values.

A second type of message required users to type in a value, as shown in Figure 4. In this case, the value the participant typed in was checked against a list of acceptable values. If the value was not in the list, the user was notified and the value rejected.

Measures

The measures employed in this study focused on team level outcomes within a negotiation context, process measures of teamwork, metacognitive skills, fixed-pie bias perceptions, and manipulation checks. Each measure is described below.

Team outcome measures. Our team outcome measures were based on the work of O'Neil et al. (1994) and were designed to measure four aspects of the negotiation scenario: (a) final counteroffer, (b) whether or not an agreement was reached, (c) if an agreement was reached, the type of agreement (i.e., integrative or distributive), and (d) elapsed time on the negotiation task.

The final counteroffer was defined as the sum of the offer levels across all three issues. If an agreement was reached between the management and union teams, the agreed-to offer was used to computer the final counteroffer. For example, if the agreed-to offer was 120-40-0, the final counteroffer was 160.

If an agreement was not reached, the final counteroffer was computed from the offer the management team would have proposed given the last union offer. For example, suppose the last union offer was 120-80-40. In response to

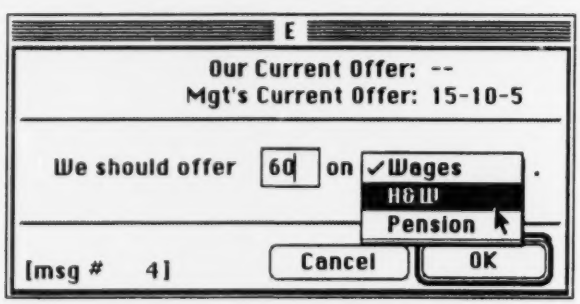

Figure 4. Message requiring user input: typing in values; selecting values.

this offer, the management team would counterpropose 0-0-0. Thus, the final counteroffer would be 0.

Agreement was defined as whether or not the union team reached an agreement with the management team. No distinction was made for the direction of the agreement. That is, a union team accepting the management team's offer was treated the same as the management team accepting the union team's offer.

Type of agreement was defined as integrative or distributive. An integrative agreement was defined as the union team reaching an agreement worth more than 120 points (see Table 6). A distributive agreement was one where the union team reached an agreement worth 120 points or less.

Elapsed time was defined as the time between the start of the negotiation and the termination of the negotiation. This time does not include the tutorial or question-answering activities.

Individual and team-level teamwork process measures. The individual and team-level teamwork process measures were designed to capture the degree to which individuals and their team engaged in each of the team processes (i.e., adaptability, cooperation, decision making, interpersonal, leadership, and overall communication). Individual team process measures were computed by counting the number of messages sent in each team process category. For example, if a team member sent 10 messages in the adaptability category, that individual's adaptability score was 10. This method was used for all categories except communication. Communication was measured by taking the total number of messages sent by an individual less the number of "I sent the wrong message" messages.

Team-level teamwork processes were measured by summing across individual category counts. For example, if all three team members sent 10 messages in the adaptability category, then the team-level adaptability performance was 30.

Self-regulation Questions

These questions consisted of measures of metacognition (planning, self-assessment, awareness, and cognitive strategies). In addition, effort and

worry were also measured. The reliability and validity data are acceptable and can be found in O'Neil, Sugrue, Abedi, Baker, and Golan (1992).

Fixed-pie Bias Questions

Two fixed-pie bias questions, based on the work of O'Neil et al. (1994), were adopted to measure the degree to which participants viewed the negotiation context as either (a) a situation where the issues being negotiated are fixed, and that a gain on one side necessarily means a loss to the other side (a "win/lose" situation), or (b) a situation where the issues being negotiated are not equally important to both sides, thus creating a potential of gaining on an important issue by giving on a less important one (a "win/win" situation).

Manipulation Checks

Nine manipulation-check questions were designed to give us a sense of (a) how well participants understood their team's priorities, (b) how adequate participants found the predefined messages to be (as a communicative device), (c) whether participants knew the identity of their teammates, (d) how easy participants found the system to use, and (e) participants' experience with computers. Appendix 4 contains a list of the manipulation check questions. Finally, participants were given an opportunity to type in messages that they would have liked to have available.

Procedure

Each participant was randomly assigned to a computer, a team, and a role (leader vs. member). The experimenters introduced themselves, informed the participants that they were part of a study examining teamwork and negotiation skills, and gave a brief overview of the scenario and the activities to follow. All participants went through a negotiation tutorial on the computer. The tutorial explained in detail the negotiation scenario, the negotiation issues and priorities, the team scenario, and how to operate the computer. (Each of these was described earlier in this report.)

Team scenario. Participants were informed that they were part of a 3-person team comprised of a leader and two members. The leader was the only one who could select offers for the union team, and send to and accept offers from the management team. The two members were responsible for advising

the leader. Participants were urged to reach consensus on what to offer the management team.

Computer use. Participants were given computer demonstrations on how to carry out critical functions such as sending messages. This demonstration consisted of playing prerecorded animated sequences that, for example, showed the mouse moving to a button, clicking on it, and showing the computer's response.

Participants who finished the computer tutorial were instructed to study the message handout while waiting for everyone else to finish. Once everyone finished the tutorial, participants began the negotiation task. At the end of the negotiation task participants were given feedback regarding their performance. Participants were shown their individual performance score (number of messages sent for each message category), team performance (total number of messages sent by all team members for each message category), and negotiation performance (whether or not an agreement was reached), type of agreement (integrative or distributive if an agreement was reached, not applicable otherwise), and elapsed time for the negotiation task. Examples of the scoring and interpretation of the results to the participants are found in Appendix 5.

Following the performance feedback, participants were presented with 34 self-regulation questions, 2 fixed-pie bias questions, and 9 manipulation check questions. In addition, they had the opportunity to type in any messages they felt the system should have had. Appendix 5 contains the full text of the questions. Following the questions, the participants were presented with screens describing the purpose of the study, the nature of integrative ("win-win") and distributive ("win-lose") agreements, and the need for effective teamwork skills in today's workplace. Students were escorted back to their classroom, debriefed, and told that they were all union teams and that the management team was played by the computer. Any questions were then answered.

Data Collection Problems

The first attempt at data collection was marred by catastrophic computer failures. The class was comprised of 18 sophomores (6 groups of 3

participants). Throughout the initial data collection session computers would crash or freeze. Only one group out of the six completed the entire experimental session. The individuals in this group participated under standard conditions in a new group the following week. Thus, the majority of participants in the first class were not exposed to the negotiation task or subsequent questionnaire-type data collection. These students participated under standard conditions in new groups the following week. The remaining three classes (which did not participate in this first attempted data collection) were rescheduled for the following week.

The computer failures were caused by an interaction of a utility used to extend the HyperCard (1993) program's functionality and the network functions of HyperCard. This utility (called a "XCMD"), which provided the window dialog capability (e.g., see Figures XX-1 and XX-2), also provided a special kind of window that could be programmatically opened and closed without user intervention (hereafter called a status window). We used status windows to notify the participant that the computer was engaged in a lengthy process. The status window also signaled to the participant that he or she should wait. Immediately after the process was finished the window was closed, signaling to the participant that he or she could continue.

However, use of the status window caused the computer to crash when the following conditions occurred simultaneously: (a) the status window was being closed and (b) a message was received from another computer. The problem was eliminated by not using status windows.

A second data collection attempt was made and completed the following week. Three computer failures occurred, of which only one failure was recoverable. During the first sessions one computer failed during the negotiation task. Members of this team were immediately escorted back to class and informed that the computer had failed. (These participants were dropped from our analysis.) The failure appeared to be similar to the one that occurred the previous week; however, we were unable to determine the exact cause of failure. During the second session, one computer failed after the participant completed the tutorial. Because there were spare computers, members of this team were moved to those computers. This incident occurred before the class started the negotiation task. The cause of this problem was a HyperCard system crash. This problem did not reoccur. The third computer

failure occurred in the third session during the negotiation task. This team was immediately escorted back to class. As with the first session, this failure appeared to be similar to the one that occurred the previous week, but its cause is unknown.

Another incident occurred in the final session—the 10th-grade resource class (18 participants or 6 groups). This session was far noisier and rowdier than the other three sessions. In particular, some of the teams that finished the negotiation task later in the session were talkative and disruptive while answering the questions. One factor that contributed to the problem was that this group ran nearly to the end of the class period, which was the last class of the school day.

Results

Message Selection Procedure

All of the messages provided in the negotiation scenario were selected from a much larger pool of potential messages derived from student messages in our pilot testing or developed by the authors to represent teamwork processes mentioned previously. The messages were sorted by two independent raters into five categories: adaptability, coordination, decision making, leadership, and interpersonal teamwork processes. Messages could be put in more than one category, with the condition that if a message was sorted into more than one category of team processes, such categories would be ordered according to the rater's perceived strength of fit for that message to each category. Thus, if Message 1 was sorted into both the leadership category and the adaptability category, leadership and adaptability would be ranked for this item according to which category the item fit into better, with 1 indicating the best fitting (primary) category, and 2 indicating the next best fitting (secondary) category. Almost all items were placed in two or fewer categories by each rater.

From this larger pool of potential messages, items were selected which showed strong agreement between the two raters for each category, with the object being to retain 10 messages in each category. Agreement between the raters occurred when both raters sorted an item into the same primary category. To obtain the desired quantity of messages in each category,

messages with secondary agreement were retained for those categories without ten messages with primary agreement. This practice provided an adequate number of messages for the leadership category. However, in the adaptability, coordination, decision making, and interpersonal teamwork process categories, one message was needed to complete the desired quantity for each category. These were determined by a third rater, who then rated those messages for which the first two raters failed to reach agreement. Thus, at least nine out of ten messages in each category (90% to 100%) resulted from primary or secondary agreement between the two initial raters. In addition, a single error message that did not fit into any of the teamwork process categories was included. The rater agreement for the five teamwork process categories is shown in Table 9.

Individual-Level Measures

Preliminary analysis of the data revealed that each of the 51 messages provided in the negotiation simulation were used at some point. The observed frequency for each message is provided in Table 10. As may be seen in Table 10, though all messages were utilized, individual message usage varied from 3 (message #26) to 551 (message #33). The frequency distributions were highly skewed positively, with most items having a mode of zero. Thus, prior to combining the items to generate team process scales, the message counts were transformed from raw score frequency of usage counts for each subject to percent of overall item usage for that subject relative to all subjects. That is, if Subject A had a frequency count of 6 on item X that had a total usage of 50, Subject A's score on item X was transformed from 6 to .12 (6/50). This put each item on a common metric (0-1) and preserved the underlying distribution because each item was merely transformed by division of a constant value.

As was mentioned earlier, during the initial class periods of data collection, software system malfunctions made it necessary to reschedule subjects to the following week, once the malfunction problems had been mostly resolved. This resulted in one of the classes having some prior exposure to the negotiation software, since the malfunctions occurred after subjects had been introduced to the system and navigated through the tutorial, but before they started the negotiation scenario.

Table 9

Rater Agreement for Teamwork Process Categories

Teamwork process	Primary agreement	Secondary agreement	Cumulative agreement for both categories
Adaptability	90%	0%	90%
Coordination	40%	50%	90%
Decision making	90%	0%	90%
Leadership	100%	0%	100%
Interpersonal	90%	0%	90%

Table 10

Frequency Count of Messages

Message #	Frequency	Message #	Frequency	Message #	Frequency
1	302	18	35	36	65
2	287	19	9	37	22
3	49	20	62	38	29
4	53	21	14	39	26
5	52	22	26	40	89
6	20	23	19	41	37
7	31	24	17	42	357
8	32	25	62	43	270
9	17	26	3	44	216
10	40	27	16	45	106
11	24	28	20	46	95
12	44	29	40	47	326
13	45	30	14	48	40
14	35	31	21	49	28
15	65	32	49	50	65
16	16	33	551	51	118
17	26	34	129		

Separate statistical analyses were conducted for those subjects who were not exposed previously to the program, for those who were, and for the group as a whole. The first session had 6 groups with varying levels of prior exposure to the program. The other three sessions had a total of 20 groups used in the analysis. Comparing those groups with exposure (N=6) to those without

exposure (N=20) on each of the outcome measures—score (M = 115, SD = 16.8 vs. M = 124, SD = 32.7); time (M = 26.5, SD = 9.0 vs. M = 28.9, SD = 9.8); agreement (83% vs. 85%); agreement type (both at exactly 50% integrative, 50% distributive)—did not result in significantly different scores. Similar results were found for comparisons on all team process categories and self-regulation measures. No differences between the groups were found. In summary, separate analyses did not result in any substantive differences in performance on any of the measures or conclusions drawn therefrom. Thus, data from all four class sessions were retained for analysis and are reported here.

For each subject, individual scores were calculated for the adaptability, coordination, decision making, leadership, and interpersonal teamwork processes by counting the messages from each category (see Appendix 2 for messages in each category). In addition, a total communication score was computed by summing each of the five teamwork process scores for each individual less the total number of error messages for that individual. An individual's scale score was not adjusted for error messages. Means and standard deviations for each scale are presented in Table 11.

As may be seen in Table 11 of the observed frequency for each process, the average participant "sent" approximately 10% of the messages in each category. Our metric does not allow comparison between categories.

Table 11

Individual-Level Teamwork Process Scales (N=81)

Process	Mean	*SD*	Minimum	Maximum
Adaptability	.11	.09	.00	.38
Coordination	.10	.12	.00	.66
Decision making	.10	.11	.00	.43
Leadership	.10	.10	.00	.46
Interpersonal	.10	.15	.00	1.07
Communication	.49	.38	.01	2.15

Teamwork Process Reliabilities

The five team process scales were subjected to reliability analysis using item raw scores (counts of times utilized), transformed item scores (proportion scores), and reduced scale proportion scores. There is an issue of independence of the item scores because a message could be selected by a participant more than once. In most examples of testing, an item can be answered only once. Thus, we explored a variety of reliability measures. We also looked at both parametric and nonparametric statistics, two of which we report here.

Improvements for each scale in inter-item consistency were made by eliminating from one to three items from each message category, based on low item-total correlations. These exclusions included eliminating item #6 from the adaptability scale; items #16, #17, and #19 from the coordination scale; items #26 and #27 from the decision making scale; items #12 and #21 from the leadership scale; and items #48 and #49 from the interpersonal scale. These results can be seen in Table 12. Cronbach's alpha coefficients ranged from .51 for adaptability to .76 for interpersonal in the reduced scales, indicating moderate inter-item consistency, with the interpersonal scale showing the greatest internal consistency.

Additionally, nonparametric statistical tests indicate moderate but significant agreement between the items on each scale. The reduced version of each scale was analyzed using Kendall's coefficient of concordance (*W* statistic; see Hays, 1973). The coefficient of concordance indicates the extent to which judges (or items) agree in their ranking of subjects. It has a range from 0 to 1, with zero indicating no agreement whatsoever, and one indicating total agreement. The statistic follows a chi-square distribution with (N-1) degrees of freedom, where N = number of subjects being judged. The null hypothesis that there is no agreement among the items can thus be tested, provided the number of items is roughly greater than or equal to 8 (Hays, 1973, p. 803), which is satisfied for all but one of these scales. The results of this analysis are presented in Table 13. The coefficients ranged from .24 to .31. In each case, the coefficient of concordance is significantly different from zero at $p <$ .001, indicating agreement among the items. Thus, both parametric and non-parametric procedures show moderate consistency and reliability for each of the five teamwork process scales.

Table 12

Summary of Reliability Analysis for Teamwork Process Scales

Teamwork process scale	Items	Adjustments	Cronbach's alpha
Adaptability	4,6,7,22,42,43,44,45,46,50	Use raw values	.49
	4,6,7,22,42,43,44,45,46,50	Use proportion scores	.43
	4,7,22,42,43,44,45,46,50	Remove #6	.51
Coordination	9,11,13,14,15,16,17,18,19,24	Use raw values	.62
	9,11,13,14,15,16,17,18,19,24	Use proportion scores	.57
	9,11,13,14,15,18,24	Remove #16, #17, #19	.63
Decision making	1,3,25,26,27,28,29,30,31,32	Use raw values	.44
	1,3,25,26,27,28,29,30,31,32	Use proportion scores	.61
	1,3,25,28,29,30,31,32	Remove #26, #27	.59
Leadership	2,5,8,10,12,20,21,23,33,34	Use raw values	.34
	2,5,8,10,12,20,21,23,33,34	Use proportion scores	.57
	2,5,8,10,20,23,33,34	Remove #12, #21	.63
Interpersonal	35,36,37,38,39,40,41,47,48,49	Use raw values	.57
	35,36,37,38,39,40,41,47,48,49	Use proportion scores	.75
	35,36,37,38,39,40,41,47	Remove #48, #49	.76

Table 13

Kendall's Coefficients of Concordance for Teamwork Scales

Process	*W* statistic	Chi-square	*df*	$p <$
Adaptability	.24	173.51	80	.001
Coordination	.31	170.92	80	.001
Decision making	.29	184.05	80	.001
Leadership	.24	154.94	80	.001
Interpersonal	.30	191.98	80	.001

Self-regulation Measures

In addition to teamwork process scores, measures of self-regulation activity were computed for each subject. These included measures of effort, worry, cognitive strategies, self-checking, planning, and awareness. The values for each of these scales were calculated by summing the items from that scale. The means, standard deviations, number of items, and coefficient alpha reliabilities for each metacognitive scale are presented in Table 14. In general, reliabilities for the metacognitive measures are acceptable, with a low of .64 for the awareness scale to a high of .84 for the effort scale.

Additional Measures

Two questions presented to each subject dealt with the issue of fixed-pie bias, or a tendency to see the negotiation as a win-lose proposition. On the first question, regarding the management team's most important issue in the negotiation scenario, 76.5% of the subjects showed a fixed-pie bias. An even greater percentage (84.0%) indicated a fixed-pie bias on the second question, dealing with the management team's least important issue. These results are consistent with our prior data on novices (O'Neil et al., 1994).

We were also concerned with whether subjects understood what the priorities of their own negotiating team were. Of the 81 subjects in the study, 71 (86.4%) indicated that they accurately comprehended their team's priorities. Moreover, since the negotiation within teams was intended to be among anonymous participants, we inquired regarding subjects' knowledge of the

Table 14

Descriptive Statistics and Reliabilities for Metacognitive Scales

Metacognitive process	Mean	*SD*	# of Items	Cronbach's alpha
Effort	20.78	3.46	6	.84
Cognitive strategies	17.15	3.59	6	.70
Worry	9.81	3.52	5	.74
Awareness	15.78	2.82	5	.64
Planning	18.78	3.66	6	.79
Self-checking	13.43	3.33	5	.74

identity of the other members in their team. In general, subjects were mostly unaware of the identity of their other team members (Table 15). The overall mean was 1.79 indicating average knowledge somewhere between 1 "Not at all" and 2 "Somewhat."

Finally, information regarding subjects' perceptions of the simulation program, message effectiveness, and computer literacy was solicited. Generally, subjects found the program to be easy to use (M = 3.40, SD = .83; [82.7% of subjects indicated either "often" or "almost always" as opposed to stating "almost never" or "sometimes"]). Though the messages didn't always capture what the subjects wanted to say (M = 2.63, SD = .90 [46.9%]), they were considered to be effective (M = 3.27, SD = .82 [81.5%]) and coherent (M = 3.52, SD = .73 [86.4%]). Additionally, the subjects indicated high levels of computer use (M = 3.37, SD = .87 [81.5%]).

Team-Level Measures

Each of the individual-level teamwork process measures was used to calculate comparable team-level scores. The individual scores for adaptability, coordination, decision making, leadership, interpersonal, and error messages were summed among the three members of each team to generate a team score for each process. A total team communication score was created by subtracting the total team error messages from the sum of the five team-level

Table 15

Means and Standard Deviations for Teammate Identity

Variable	Mean	*SD*
Knowledge of leader	1.83	1.22
Knowledge of member 1	.70	1.14
Knowledge of member 2	1.83	1.19
Overall	1.79	1.02

Note. These values were computed excluding self-knowledge (i.e., Leaders were excluded from the Knowledge of Leader question, M1s were excluded from the Knowledge of Member 1 question, and M2s were excluded from the Knowledge of Member 2 question).

teamwork process scores. Means, standard deviations, and intercorrelations for each of the team-level teamwork process measures are presented in Table 16. Communication is a composite (simple sum) of the other five team process measures, which are restricted to a 0-1 range. However, the range for Communication is from .22 to 3.05. Unlike the other team process measures, Communication is a composite, rather than a proportion.

Outcome Measures

The negotiation scenario generated a total of four team-level outcome measures: team performance score, whether an agreement was reached, type of agreement reached, and time spent on the negotiation. Team performance scores were calculated for teams reaching agreement as the total point value of the agreed-upon offer. For teams not reaching an agreement, a team performance score was computed by taking the total point value of the inverse of the last offer submitted by the negotiating team. Upon inspection, we found one team that completely misunderstood the concept of the scenario, which resulted in a team score of zero. Through discussions with the members of this team, we realized they mistakenly believed that a score of 0 was their ideal result, as opposed to the instructions indicating the objective was to maximize the points for their team according to their stated priorities. As a result, this team was excluded, leaving data for 26 teams for all team analysis.

Table 16

Descriptives and Intercorrelations for Team-Level Teamwork Process Measures

Process	Mean	*SD*	2	3	4	5	6
1. Adaptability	.33	.20	.69***	.82***	.49**	.61***	.89***
2. Coordination	.28	.21		.72***	.65***	.45*	.88***
3. Decision making	.29	.20			.66***	.41*	.89***
4. Leadership	.28	.18				.37	.77***
5. Interpersonal	.24	.15					.66***
6. Communication	1.38	.76					

* $p < .05$. ** $p < .01$. *** $p < .001$.

The outcome measure of agreement was coded dichotomously (1 = agreement; 0 = no agreement). The great majority of teams reached an agreement within the 8-round negotiating session (85%). Agreement type was determined by the value of the overall score measure. Teams with overall scores greater than 120 received a score of 1, indicating an integrative agreement. Teams with overall scores less than or equal to 120 received a score of 0, indicating a distributive agreement. Time spent in the negotiation scenario was captured by the program for each team and is reported in minutes. Descriptive statistics for each of these measures can be found in Table 17.

Tests of Hypotheses

We hypothesized several relationships between the teamwork processes and outcome measures, as well as some relationships among the outcome measures themselves. Our unit of analysis was the team (N=26), not the individual student. Our first hypothesis was that team processes would be positively associated with team performance. This hypothesis was generally supported by the direction and moderate magnitude of the correlations between these measures; however, few are statistically significant. Failure to find statistical significance for these correlations is not surprising considering the relatively low power of this test given a sample size of only 26. According to Cohen (1992), for a correlation coefficient test of significance with a power of .80 to detect even a small effect size (defined by Cohen to be > .10) at the .05 level of significance would require a sample size of N = 783. To detect a medium effect size (e.g., > .30), a sample size of N = 85 would be required. In the current study, only large effect sizes (e.g., > .50) could be expected to be detected (necessary sample size, N = 28).

Table 17

Descriptives Statistics for Team-Level Outcome Measures (N = 26)

Outcome measure	Mean	*SD*	Minimum	Maximum
Performance score	121.73	21.07	50	150
Agreement	.85	.37	0	1
Agreement type	.50	.51	0	1
Time in negotiation (min)	28.31	9.02	13.00	44.00

Table 18 provides the correlations between the teamwork processes and outcome measures (Hypothesis 1). Correlation coefficients for team performance and adaptability, coordination, and leadership range from .29 to .31. The correlation between team performance and team communication is higher (r = .36) and approaches significance (p = .07). Only team decision making was significantly related to team performance (r = .41; p < .04). The interpersonal teamwork process showed no relationship to team performance (r = .03; p > .88); however, it did show a strong negative relationship with reaching an agreement (r = - .52; p < .01). Apparently, though most teams reached an agreement, those teams that failed to reach an agreement (4 of 26 teams, or 15%) utilized more interpersonal messages than did teams that reached an agreement. This statement is implied by the negative correlation between agreement and the interpersonal team process measure (-.52**). However, the mean values of the interpersonal measure for each of these groups (agreement vs. non-agreement) are listed in Table 19: These differences are significant at the p < .01 level (t value = 3.00, df = 24).

Similar results are found for our additional hypothesis that teamwork processes would be positively associated with quality of agreement. Again, moderate positive but nonsignificant correlations were found between type of agreement and adaptability, coordination, leadership, and communication (r's

Table 18

Correlations Between Team Processes and Outcome Measures (N = 26)

Team process	Performance score	Agreement	Agreement type	Time in negotiations
Adaptability	.31	-.24	.24	.72***
Coordination	.29	-.08	.15	.65***
Decision making	.41*	-.04	.41*	.69***
Leadership	.32	-.02	.19	.65***
Interpersonal	.03	-.52**	-.05	.56***
Communication	.35	-.20	.24	.80***

* p < .05. ** p < .01. *** p < .001

Table 19

Means and Standard Deviations Between Teams With and Without Agreement

Team outcome	Mean	*SD*	SE
Agreement (*N*=22)	.20	.13	.03
Non-agreement (*N*=4)	.42	.16	.08

= .24, .15, .19, and .24 respectively). Decision making showed a significant positive relationship with agreement type (r = .41; p < .04), but as with team performance, the interpersonal teamwork process showed no relationship to quality of agreement (r = -.04; p > .81).

There was more support for our prediction of a positive relationship with the teamwork processes and time involved in negotiation. All of the correlation coefficients between time involved in negotiation and the teamwork processes are positive and significant beyond the p < .001 level. They range from a low of .56 for the interpersonal scale to a high of .80 for the communication measure. Thus, not surprisingly, more communication of all types among the team members is related to longer time involved in the negotiation process.

Our second hypothesis predicted that team performance would be negatively related to time in negotiations. Results for this prediction are mixed. Although time in the negotiation scenario was negatively related to reaching an agreement (r = -.40; p < .05), the correlation between time and team performance was positive but not significant (r = .28, p > .16). Similarly, results indicate no relationship between time and agreement type (r = .10; p > .64). Thus, teams that reached agreement took less time in the negotiations, as we predicted. However, less time did not relate to significantly higher team performance values or better agreements.

The third hypothesis proposed a negative relationship between team performance and the degree of fixed-pie bias exhibited by the team. Team-level fixed-pie bias was calculated as the sum of bias exhibited by the three members of the team on two questions; thus, the possible range for this team-level variable is from 0 (no bias by any member on either of the two questions) to 6

(all three members exhibit bias on both of the fixed-pie questions). However, due to the large amount of bias shown at the individual level (recall 76.5% on the first question and 84% on the second question), the team bias score ranged from 3 to 6 (M = 4.81; SD = 1.02). Correlations between team performance measures and team level bias did not support our hypotheses. Contrary to our prediction, the relationship between team performance and bias (r = .29; p > .15) was positive but not significant. Likewise, no significant relationship was found between bias and type of agreement (r = .04; p > .85).

We also proposed relationships between the self-regulation measures (effort, cognitive strategies, worry, awareness, planning, and self-checking) and team performance measures (Hypothesis 4). All but worry were predicted to show positive correlations with the team performance measures (Table 20). Though not all of the proposed relationships were exhibited, we found support for the measures of effort and cognitive strategies. Teams exhibiting more effort on the task showed higher team performance (r = .57; p < .005) and better agreements (r = .57; p < .005). Likewise, teams higher on the cognitive strategy measure showed higher performance (r = .38; p = .05) and better agreements (r = .36; p <.07), though this relationship only approached statistical significance. As seen in Table 20, none of the other relationships are significant, though many are in the proposed directions and are of low to moderate magnitudes, magnitudes that are consistent with earlier research in this area (e.g., Brannick et al., 1993). As noted earlier, one of the limitations of sample sizes

Table 20

Correlations Between Metacognitive and Outcome Measures (N = 26)

Metacognitive scale	Performance score	Agreement	Agreement type	Time in negotiations
Effort	.57**	.48*	.57**	.08
Cognitive strategies	.38*	.23	.36	.15
Worry	-.26	-.21	-.33	.25
Awareness	.22	.23	.16	-.03
Planning	.30	.26	.28	.26
Self-checking	-.15	.08	-.17	.23

* p < .05. ** p < .01. *** p < .001

as small as the one used in these group level analyses (N = 26) is that all but very large effects are not likely to be detected and recognized as statistically significant. Clearly, additional investigations with more groups are desirable to ferret out small to moderate effects of teamwork processes and metacognitive activities on team performance outcomes.

Discussion

The results of this study indicate that the measurement of teamwork processes can be accomplished in a reasonably reliable and much more time-efficient manner than that of earlier approaches. The entire negotiation procedure, including individual and team process and outcome scoring and interpretation, took place in less than one extended class period. This kind of improvement in the timeliness of data collection and analysis without a loss in the reliability and validity of such measures greatly enhances the ability of researchers to address pressing issues and speeds up the accumulation of knowledge in the area.

In addition, as an initial small-scale investigation, this study provides promise that larger scale experimentation may provide more stable and statistically significant estimates of the relationships between teamwork measures, such as adaptability, coordination, decision making, leadership, and interpersonal processes, and outcome measures, such as whether negotiated agreements are reached, the type and quality of those agreements, and the time involved in reaching such agreements.

Moreover, we have shown that the use of technology, specifically computerized networked simulations, can be effectively incorporated in assessing the relationships among these relevant issues. Students found the simulation to be interesting, easy to use, effective, and enjoyable. Few other testing procedures enjoy such enthusiastic, positive appraisal from the test-taking populace. Acceptance of and support for the procedure by students can facilitate additional investigations in the area and may lead to additional improvements in the way teamwork processes and other relevant constructs are measured.

Improving the ability to assess teamwork skills and their relationships to performance outcomes will serve not only the interests of educational

researchers but also the interests of training and development specialists, and American industry as well. With the increasing importance placed on teamwork skills in the private sector, and the desire to encourage and develop such abilities in young adults entering the workforce, the development of efficient teamwork taxonomies and assessment procedures is of critical importance. This study provides direction in pursuing this objective and moves us closer to accomplishing that goal.

In conclusion, existing measures of team processes are labor intensive (think-aloud protocols or ratings of videotaped team sessions) and thus are not timely. Our approach suggests the feasibility of computer-scoring and reporting of team processes in real time. We plan to conduct more statistical analysis to understand more clearly the relationship between team processes and outcomes. Each student, when finished with the simulation, would have a score for each team process (e.g., coordination or leadership) as well as a score of the team outcome. Our software approach has been designed to be domain independent and thus should transfer to other computer-based team environments. Such a reliable and valid measure would offer the capability of assessing quickly team processes and outcomes in collaborative learning environments (K–12) or team training in industry or the military.

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Appendix 1

Algorithm of Simulated Management Team's Response

Computer-Simulated Offers Algorithms

Notation/definitions:
H[1] = human offer on issue 1
H[2] = human offer on issue 2
H[3] = human offer on issue 3
Inverse: reflection about issue E. The inverse of A = I; of C = G; of E = E.
Mirror: one-for-one match. The mirror of A = A; of C = C; of E = E.

Computer Offer on Issue 1:
If H[1] < E, computer offer = inverse of H[3]
If H[1] >= E, computer offer = mirror of H[3]

For example:

For H[1] < E:

H[3]	Issue 1 Offer
A	I
B	H
C	G
D	F
E	E
F	D
G	C
H	B
I	A

For H[1] >= E:

H[3]	Issue 1 Offer
A	A
B	B
C	C
D	D
E	E
F	F
G	G
H	H
I	I

Computer Offer on Issue 2:

If H[2] < E, computer offer = inverse of H[2]
If H[2] >= E, computer offer = mirror of H[2]

For example:

H[2]	Issue 2 Offer
A	I
B	H
C	G
D	F
E	E
F	F
G	G
H	H
I	I

Computer Offer on Issue 3:

If H[1] < E, computer offer = inverse of H[1]
If H[1] >= E, computer offer = mirror of H[1]

For example:

For H[1] < E:

H[1]	Issue 3 Offer
A	I
B	H
C	G
D	F
E	E
F	F
G	G
H	H
I	I

For H[1] >= E:

H[1]	Issue 3 Offer
A	I
B	H
C	G
D	F
E	E
F	F
G	G
H	H
I	I

HyperCard code to implement the above.

```
__ computeScore
```

```
function computeScore usOrThem, issue1Line, issue2Line, issue3Line
  if usOrThem = 1 then
    -- compute score for us (human)
    -- line 1 = highest score, line 9 = lowest (0)
    -- -15 * lineNo + 135 = issue 1 score
    -- -10 * lineNo +  90 = issue 2 score
    -- -5  * lineNo +  45 = issue 3 score
    put (-15 * issue1Line + 135) +
        (-10 * issue2Line +  90) +
        (-5  * issue3Line +  45) into score

  else
    -- compute score for them (computer)
    -- line 9 = highest score, line 1 = lowest (0)
    --  5 * lineNo -  5 = issue 1 score
    -- 10 * lineNo - 10 = issue 2 score
    -- 15 * lineNo - 15 = issue 3 score
    put (5  * issue1Line - 5)  +
        (10 * issue2Line - 10) +
        (15 * issue3Line - 15) into score
  end if

  return score
end computeScore
```

```
__ computeResponseToOurOffer
on computeResponseToOurOffer
  global gIssue1OfferUsLine    -- line no in field
  global gIssue2OfferUsLine    -- line no in field
  global gIssue3OfferUsLine    -- line no in field

  global gIssue1OfferThemLine -- line no in field
  global gIssue2OfferThemLine -- line no in field
  global gIssue3OfferThemLine -- line no in field


  -- 'our' means the offer we (ie, computer users) are giving to
hypothetical
  -- them (computer simulation)

  -- compute offer 1 response
  if gIssue1OfferUsLine < 5 then
    -- simulated response = inverse on issue 3 of human
    put 10 - gIssue3OfferUsLine into gIssue1OfferThemLine
  else
    -- simulated response = mirror on issue 3 of human
    put gIssue3OfferUsLine into gIssue1OfferThemLine
  end if

  -- offer 2 response
  if gIssue2OfferUsLine < 5 then
    -- simulated response = inverse on issue 2 of human
    put 10 - gIssue2OfferUsLine into gIssue2OfferThemLine
  else
    -- simulated response = mirror on issue 2 of human
    put gIssue2OfferUsLine into gIssue2OfferThemLine
  end if

  -- offer 3 response
  if gIssue1OfferUsLine < 5 then
    -- simulated response = inverse on issue 1 of human
    put 10 - gIssue1OfferUsLine into gIssue3OfferThemLine
  else
    -- simulated response = mirror on issue 1 of human
    put gIssue1OfferUsLine into gIssue3OfferThemLine
  end if


end computeResponseToOurOffer
```

Appendix 2

Messages Grouped by Category and by Message Number

Items requiring input from participants are denoted by X, Y, Z, and brackets. For example, in message number 4, "We should offer X on [W/H&W/P]," X indicates that the participant needs to enter a value, and [W/H&W/P] indicates that the participant needs to choose Wages, Health and Welfare, or Pension. Thus, an example of the fully resolved message would be "We should offer 120 on Wages." Note that under the Agreement Column, "P" denotes primary agreement, "S" denotes secondary agreement, and "R" denotes reconciled by a third rater.

Messages Grouped by Category

Msg. #	Message	Agreement
	Adaptability	
4	We should offer X on [W/H&W/P].	P
6	If we give on [W/H&W/P], they might give on [W/H&W/P].	P
7	How [low/high] should we go on [W/H&W/P]?	P
22	What issue is [least/most] important to them?	P
42	I agree with [M1/M2/LD].	P
43	I disagree with [M1/M2/LD].	P
44	What do you think, [M1/M2/LD]?	P
45	What does the team think?	R
46	Any ideas?	P
50	Should we accept their offer?	P
	Coordination	
9	We should each figure out our preferences, and then share them.	R
11	We need to hurry to complete this round.	P
13	We only have X rounds left.	P
14	Keep track of the time.	S
15	We need to get an agreement.	S
16	I think we should be making offers we seriously think they might take by the 6th round.	S
17	Should we hold tough until near the end, or start moving toward a compromise now?	S
18	We should compromise now.	S
19	We should coordinate our activities.	P
24	We should sequence our offers so as to gain agreement.	S
	Decision making	
1	What if we offer X-Y-Z?	P
3	What if we offer X on [W/H&W/P]?	R
25	We should go higher on [W/H&W/P] because it's OUR [1st/2nd/3rd] priority.	P
26	We should go higher on [W/H&W/P] because it's THEIR [1st/2nd/3rd] priority.	P
27	If we don't go higher on [W/H&W/P], then we'll be sacrificing our position.	P

Msg. #	Message	Agreement
	Decision making (continued)	
28	If we don't go higher on [W/H&W/P], then we'll get a bad deal.	P
29	We should go lower on [W/H&W/P] because it's OUR [1st/2nd/3rd] priority.	P
30	We should go lower on [W/H&W/P] because it's THEIR [1st/2nd/3rd] priority.	P
31	We should go lower on [W/H&W/P] because we can afford to.	P
32	We should go lower on [W/H&W/P] because it increases our chances of an agreement.	P
	Interpersonal	
35	We should all agree on the final offer.	P
36	We have to work together on this.	P
37	Our members are counting on us to be an effective team.	P
38	With everyone's contribution, I'm sure we're going to be successful.	P
39	I think everyone's helping. Let's keep it up.	P
40	Help me out.	P
41	Do you need any help?	P
47	Good idea.	P
48	I think you've got the right idea.	P
49	It's important that we all contribute.	P
	Leadership	
2	Let's offer X-Y-Z.	P
5	We should [give/hold/raise] on [W/H&W/P].	P
8	We should maximize our total points.	P
10	Let's go [higher/lower] and see what they do.	P
12	Let's make a decision now.	P
20	Our [1st/2nd/3rd] priority is [W/H&W/P].	P
21	Let's assume the management team's [1st/2nd/3rd] priority is [W/H&W/P].	P
23	Let's think about what our strategy should be.	P
33	Send the offer.	P
34	Should we send our offer?	P
	Other	
51	I sent the wrong message (clicked on wrong button).	

Messages Sorted by Message Number

Msg. #	Message	Agreement
1	Decision making	What if we offer X-Y-Z?
2	Leadership	Let's offer X-Y-Z.
3	Decision making	What if we offer X on [W/H&W/P]?
4	Adaptability	We should offer X on [W/H&W/P].
5	Leadership	We should [give/hold/raise] on [W/H&W/P].
6	Adaptability	If we give on [W/H&W/P], they might give on [W/H&W/P].
7	Adaptability	How [low/high] should we go on [W/H&W/P]?
8	Leadership	We should maximize our total points.
9	Coordination	We should each figure out our preferences, and then share them.
10	Leadership	Let's go [higher/lower] and see what they do.
11	Coordination	We need to hurry to complete this round.
12	Leadership	Let's make a decision now.
13	Coordination	We only have X rounds left.
14	Coordination	Keep track of the time.
15	Coordination	We need to get an agreement.
16	Coordination	I think we should be making offers we seriously think they might take by the 6th round.
17	Coordination	Should we hold tough until near the end, or start moving toward a compromise now?
18	Coordination	We should compromise now.
19	Coordination	We should coordinate our activities.
20	Leadership	Our [1st/2nd/3rd] priority is [W/H&W/P].
21	Leadership	Let's assume the management team's [1st/2nd/3rd] priority is [W/H&W/P].
22	Adaptability	What issue is [least/most] important to them?
23	Leadership	Let's think about what our strategy should be.
24	Coordination	We should sequence our offers so as to gain agreement.
25	Decision making	We should go higher on [W/H&W/P] because it's OUR [1st/2nd/3rd] priority.

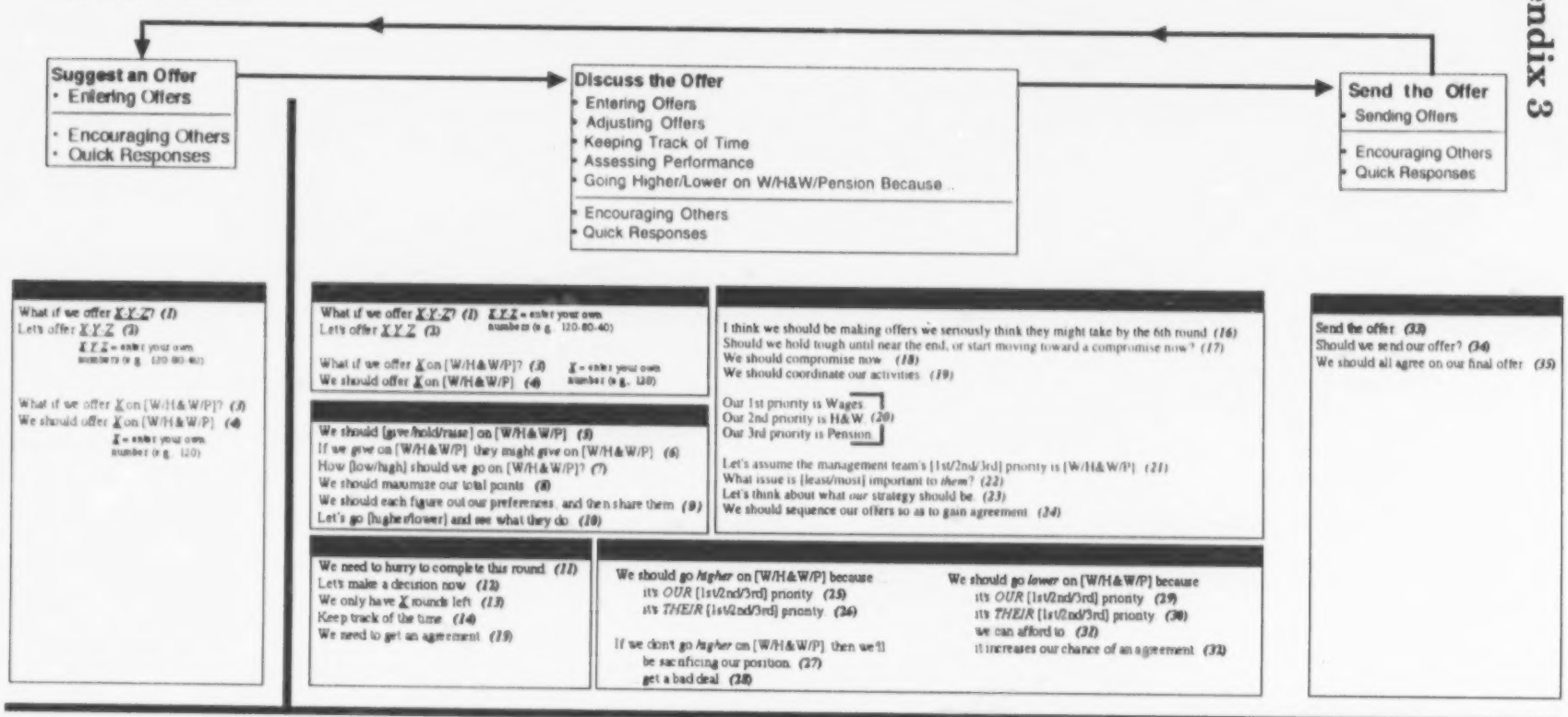
Msg. #	Message	Agreement
26	Decision making	We should go higher on [W/H&W/P] because it's THEIR [1st/2nd/3rd] priority.
27	Decision making	If we don't go higher on [W/H&W/P], then we'll be sacrificing our position.
28	Decision making	If we don't go higher on [W/H&W/P], then we'll get a bad deal.
29	Decision making	We should go lower on [W/H&W/P] because it's OUR [1st/2nd/3rd] priority.
30	Decision making	We should go lower on [W/H&W/P] because it's THEIR [1st/2nd/3rd] priority.
31	Decision making	We should go lower on [W/H&W/P] because we can afford to.
32	Decision making	We should go lower on [W/H&W/P] because it increases our chances of an agreement.
33	Leadership	Send the offer.
34	Leadership	Should we send our offer?
35	Interpersonal	We should all agree on the final offer.
36	Interpersonal	We have to work together on this.
37	Interpersonal	Our members are counting on us to be an effective team.
38	Interpersonal	With everyone's contribution, I'm sure we're going to be successful.
39	Interpersonal	I think everyone's helping. Let's keep it up.
40	Interpersonal	Help me out.
41	Interpersonal	Do you need any help?
42	Adaptability	I agree with [M1/M2/LD].
43	Adaptability	I disagree with [M1/M2/LD].
44	Adaptability	What do you think, [M1/M2/LD]?
45	Adaptability	What does the team think?
46	Adaptability	Any ideas?
47	Interpersonal	Good idea.
48	Interpersonal	I think you've got the right idea.
49	Interpersonal	It's important that we all contribute.
50	Adaptability	Should we accept their offer?
51	Other	I sent the wrong message (clicked on wrong button).

Appendix 3

Use this diagram to help you find messages. Each block represents a step in the negotiation process. Each block lists some categories that contain messages you might find useful.

For example, after the management team makes an offer, you might want to use a message in the "Entering Offers" category to suggest (to other teammates) a counter-offer.

Then, you and your teammates might want to discuss the offer, and finally send the offer to the management team.


Suggest an Offer
• Entering Offers
• Encouraging Others
• Quick Responses
Discuss the Offer
• Entering Offers
• Adjusting Offers
• Keeping Track of Time
• Assessing Performance
• Going Higher/Lower on W/H&W/Pension Because ..
• Encouraging Others
• Quick Responses
Send the Offer
• Sending Offers
• Encouraging Others
• Quick Responses
What if we offer X Y Z? (1)
Let's offer X Y Z (2)
X Y Z = enter your own numbers (e.g. 120-80-40)
What if we offer X on [W/H&W/P]? (3)
We should offer X on [W/H&W/P] (4)
X = enter your own number (e.g. 120)
What if we offer X Y Z? (1) X Y Z = enter your own numbers (e.g. 120-80-40)
Let's offer X Y Z (2)
What if we offer X on [W/H&W/P]? (3) X = enter your own number (e.g., 120)
We should offer X on [W/H&W/P] (4)
We should [give/hold/raise] on [W/H&W/P] (5)
If we give on [W/H&W/P] they might give on [W/H&W/P] (6)
How [low/high] should we go on [W/H&W/P]? (7)
We should maximize our total points (8)
We should each figure out our preferences, and then share them (9)
Let's go [higher/lower] and see what they do (10)
I think we should be making offers we seriously think they might take by the 6th round (16)
Should we hold tough until near the end, or start moving toward a compromise now? (17)
We should compromise now (18)
We should coordinate our activities (19)
Our 1st priority is Wages
Our 2nd priority is H&W (20)
Our 3rd priority is Pension
Let's assume the management team's [1st/2nd/3rd] priority is [W/H&W/P] (21)
What issue is [least/most] important to them? (22)
Let's think about what our strategy should be. (23)
We should sequence our offers so as to gain agreement (24)
Send the offer (32)
Should we send our offer? (34)
We should all agree on our final offer (35)
We need to hurry to complete this round (11)
Let's make a decision now (12)
We only have X rounds left (13)
Keep track of the time (14)
We need to get an agreement (15)
We should go higher on [W/H&W/P] because
it's OUR [1st/2nd/3rd] priority (25)
it's THEIR [1st/2nd/3rd] priority (26)
If we don't go higher on [W/H&W/P] then we'll
be sacrificing our position. (27)
get a bad deal (28)
We should go lower on [W/H&W/P] because
it's OUR [1st/2nd/3rd] priority (29)
it's THEIR [1st/2nd/3rd] priority (30)
we can afford to (31)
it increases our chance of an agreement (33)
We have to work together on this (36)
Our members are counting on us to be an effective team. (37)
With everyone's contribution, I'm sure we're going to be successful (38)
I think everyone's helping. Let's keep it up (39)
Help me out. (40)
Do you need any help? (41)
I agree with [M1/M2/LD] (42)
I disagree with [M1/M2/LD] (43)
What do you think, [M1/M2/LD]? (44)
What does the team think? (45)
Any ideas? (46)
Good idea. (47)
I think you've got the right idea. (48)
It's important that we all contribute. (49)
Should we accept their offer? (50)
I sent the wrong message (clicked on wrong button) (51)

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Appendix 4

Self-regulation Questions

1. I concentrated as hard as I could on the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

2. I wasn't happy with my performance.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

3. I thought through the meaning of the negotiation issues before I began sending messages.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

4. I noted the negotiation issues I wasn't sure of so I could go back if there was time.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

5. I did not give up, even if the negotiation task was hard.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

6. I was aware of which thinking technique or strategy to use and when to use it.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

7. I tried to do my best on the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

8. I put forth my best effort.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

9. I made sure I understood just what had to be done and how to do it.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

10. I developed a plan for the solution of the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

11. I attempted to discover the main ideas in the negotiation issues.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

12. I worked hard on the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

13. I did not feel very confident about my performance on the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

14. I attempted to use the big or major principles to complete the negotiation task.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

15. I was concerned about what would happen if I did poorly.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

16. I asked myself how the negotiation issues related to what I already knew.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

17. I corrected my errors.
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

18. I was aware of my ongoing thinking processes.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

19. I determined how to solve the negotiation task.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

20. I kept working, even on difficult negotiation issues.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

21. I was aware of my own thinking.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

22. I was afraid I should have studied the tutorial more for this negotiation task.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

23. I went over what I knew about the negotiating issues (Wages, Health & Welfare, Pension).
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

24. I felt regretful about my performance on the negotiation task.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

25. I thought my performance was bad, so everyone, including myself, would be disappointed.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

26. I tried to understand the negotiation issues before I attempted to send messages.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

27. On difficult negotiation issues, I spent more time trying to understand them.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

28. I tried to determine what the negotiation task required.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

29. I checked my performance while I was doing the negotiation task.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

30. I selected and organized relevant information to perform the negotiation task.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

31. I was aware of my trying to understand the negotiation issues before I attempted to send messages.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

32. I judged the correctness of my performance.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

33. I was aware of the need to plan my course of action.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

34. I tried to understand the goals of the negotiation task before I attempted to send messages.
    (A) Not at All
    (B) Somewhat
    (C) Moderately So
    (D) Very Much So

Fixed-Bias Questions

1. What issue do you think was the MOST IMPORTANT to the MANAGEMENT team in the negotiation?
   *(A) Pension
   (B) Health & Welfare
   (C) Wages

2. What issue do you think was the LEAST IMPORTANT to the MANAGEMENT team in the negotiation?
   (A) Pension
   (B) Health & Welfare
   *(C) Wages

Manipulation Check Questions

3. YOUR team's priorities were:
   (A) 1st: Health & Welfare, 2nd: Pension, 3rd: Wages
   (B) 1st: Pension, 2nd: Health & Welfare, 3rd: Wages
   (C) 1st: Pension, 2nd: Health & Welfare, 3rd: Wages
   *(D) 1st: Wages, 2nd: Health & Welfare, 3rd: Pension

4. Do you know who M1 is?
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

5. Do you know who M2 is?
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

6. Do you know who LD is?
   (A) Not at All
   (B) Somewhat
   (C) Moderately So
   (D) Very Much So

7. Did the messages capture what you wanted to say?
   (A) Almost Never
   (B) Sometimes
   (C) Often
   (D) Almost Always

---

* Correct answer.

8. Did you put much effort into finding the message that most closely matched what you wanted to say?
   (A) Almost Never
   (B) Sometimes
   (C) Often
   (D) Almost Always

9. Were you able to follow the "electronic conversation"?
   (A) Almost Never
   (B) Sometimes
   (C) Often
   (D) Almost Always

10. Did you find it easy to use the computer system?
   (A) Almost Never
   (B) Sometimes
   (C) Often
   (D) Almost Always

11. Do you use computers?
   (A) Almost Never
   (B) Sometimes
   (C) Often
   (D) Almost Always

12. Was there anything you really wanted to say but didn't find in the messages? If so, please type in the message(s) in the space below. Enter as many messages as you like, starting with the most important ones.

Appendix 5

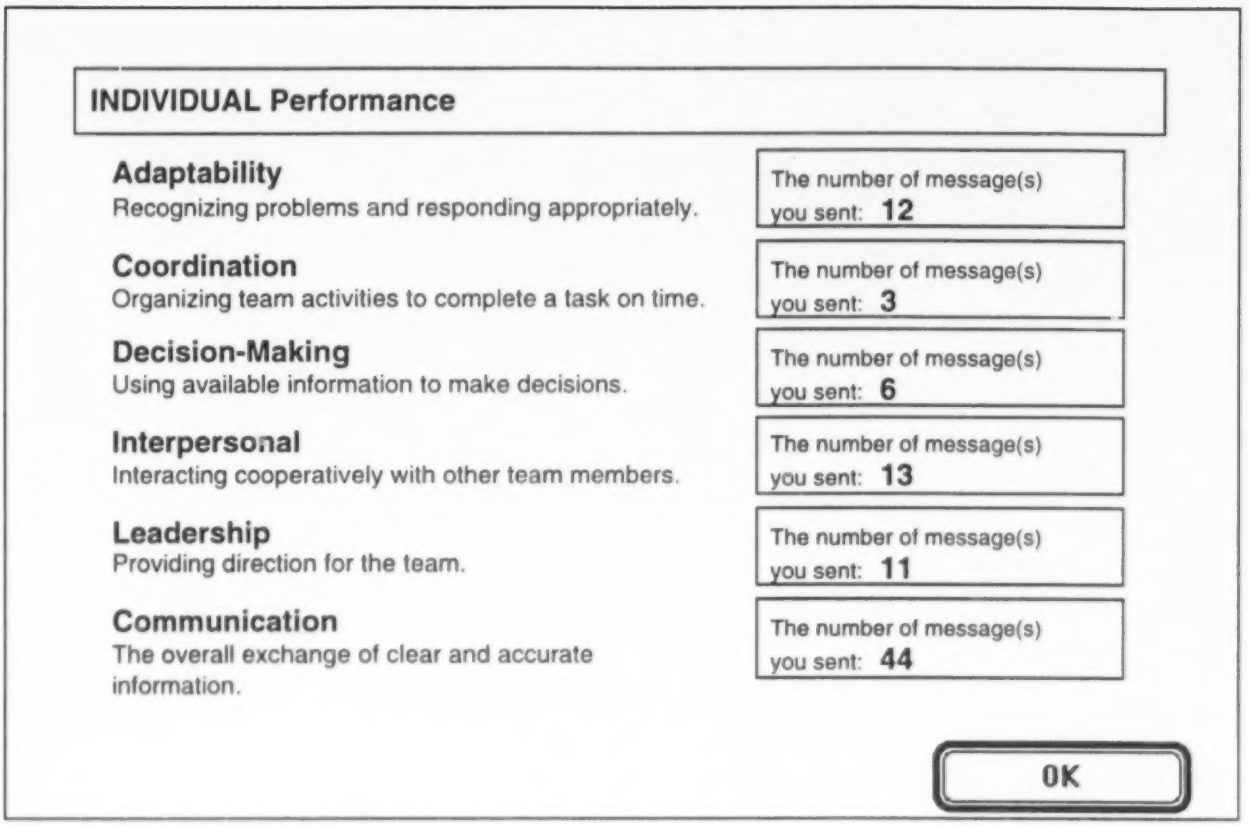
Computer Screen Shots of Individual and Team Performances

Teamwork Skills

This simulation was designed to measure some of the processes that have been identified as being important for team negotiation skills. In particular, five processes were measured: (1) adaptability – recognizing problems and responding appropriately, (2) coordination – organizing team activities to complete a task on time, (3) decision-making – using available information to make decisions, (4) interpersonal – interacting cooperatively with other team members, (5) leadership – providing direction for the team, and (6) communication – the overall exchange of clear and accurate information.

The next screen provides a description of each process and shows how many messages you sent. We used the number and type of messages as the means to measure team processes. Past research has shown that members of successful teams generally use team processes more often than unsuccessful teams. Note that 'Communication' represents the total number of messages sent, and roughly represents how active as a team member you were.

OK


INDIVIDUAL Performance
Adaptability
Recognizing problems and responding appropriately.
The number of message(s) you sent: 12
Coordination
Organizing team activities to complete a task on time.
The number of message(s) you sent: 3
Decision-Making
Using available information to make decisions.
The number of message(s) you sent: 6
Interpersonal
Interacting cooperatively with other team members.
The number of message(s) you sent: 13
Leadership
Providing direction for the team.
The number of message(s) you sent: 11
Communication
The overall exchange of clear and accurate information.
The number of message(s) you sent: 44
OK

TEAM Performance

Whereas the previous screen showed you the number of messages sent by you, the next screen will show the number of messages sent by your TEAM. That is, for each team process (e.g., adaptability), you will see the total number of messages sent by you and your teammates.

Past research has shown that members of successful teams generally use team processes more than unsuccessful teams.

OK

TEAM Performance

Adaptability
Recognizing problems and responding appropriately.

The number of message(s) your TEAM sent: **40**

Coordination
Organizing team activities to complete a task on time.

The number of message(s) your TEAM sent: **22**

Decision-Making
Using available information to make decisions.

The number of message(s) your TEAM sent: **28**

Interpersonal
Interacting cooperatively with other team members.

The number of message(s) your TEAM sent: **17**

Leadership
Providing direction for the team.

The number of message(s) your TEAM sent: **50**

Communication
The overall exchange of clear and accurate information.

The number of message(s) your TEAM sent: **155**

OK

TEAM Negotiation Performance

The next screen will show you how well your team did on your negotiation task.

You will be shown three things:

(1) Whether or not your team reached an agreement with the management team.

(2) If your team reached an agreement – the type of agreement. This will be explained in more detail on the next screen.

(3) How long your team took to complete the negotiations.

OK

TEAM Negotiation Performance

Agreement Reached?
Whether or not your team reached an agreement with the management team.

Agreement reached.

Type of Agreement
We built into the negotiation task two kinds of agreement, integrative and distributive.

Integrative

Integrative: "win-win" agreement. Your team gets what you want, the management team gets what they want.

Distributive: "win-lose" agreement. One team gets what they want at the expense of the other team.

Elapsed Time
The time it took for your team to complete the negotiation task.

28 min., 51 sec.

OK

Appendix 6

List of messages and comments participants entered. Entries are listed by participant ID number.

#3
This was a fun program. I hope you are successful of selling this program

#4
What do you want me to do about the other team.

#6
We should go lower so that they will agree ,where if we were

#7
I think we did real well..there were times of disagreement but we fought back. I liked it

#8
Send the message now!
You're wrong

#14
I think m1/m2/ld should put more effort in?

#18
I am sorry.
Lets send this offer
what was the offer again?
why?

#19
I really dislike your idea. Don't you know that if you go lower, the team will get less than it deserves. If we go higher, they won't lower the prices.

#20
why don't we do this,...?
why are you so stubborn?
stop messing around!
why such a high offer?
send this offer or else...!
come on, pleeeeze offer this!?
fine, do it without me!
some offer!!
this is all your fault!
forget it!
darn!!

#34
Why didn't you people help me out.
You all mess around to much. THANKS A LOT!!!!!!!

#35
the leader s**ks
you talk too much
send it you freak!
this is fun
who are you
you mama

#36
shut up
then decide on something you DO like!!!!!!!!
why did you do that
go home!!!!!

#43
shut up
that's dumb
your a moron
geat f**king idea

#53
IT WOULD PROBABLY BE A BETTER SYSTEM IF YOU COULD ACTUALLY TYPE IN YOUR OWN RESPONSES TO OTHER TEAMMATES. I WAS UNDER THE IMPRESSION THAT THIS IS WHAT WE'D BE ABLE TO DO.

#54
Are you sure?

#56
don't send offer yet!!!
send offer we both agree on the decision.

#61
yes
no

#62
Well I felt that if you were able to write what you wanted to say in addition with the quick responses, It would make it a better program to use...

#65
I just wanted some more quick responses and maybe some messages with more user input.

#67
is everything fine
do you think changes should be made
what can I do to make it better

#68
we need to start high and compromise from there

#073
I'm not too sure about that.
On a 1-5 scale, what do you rate the offer they gave us?
Why?
Can we make a compromise?
No
Yes
Do happen to know their priorities?
Whose offer should I send, M1 or M2?
Are you sure they will accept that offer, looking at their last offer to us?

#074
The message-sending was fun, but I think that the negotiation situation should be clarified. At first, I was somewhat confused about what we were doing; luckily after the negotiations began I caught on. Maybe there should be a scenario so that students will better understand this activity.

#75
All I needed to say were in the programmed messages.

#76
Hello? Is anyone there

#078
I would like to suggest more versatility with messages being sent. I realize that giving us the opportunity to send whatever we wanted to say might result in some unimportant messages. But considering how responsible I think I am and the seriousness of this issue if it was in real life, I think that there should be a way that we can express ourselves if we cannot find an appropriate message.
Why do you think that?

#081
What do you mean by...?
I think they will agree with our offer.
We should go higher on (wages/h&w/P) because they seem like they will go along with it.
If we go higher on (W/H&W/P), then they might not agree and lower the entire thing.

#83
yes
no
Does everyone agree?
[M1/M2/LD] needs to contribute more
Sorry.

#84
You idiot! What did you do?!?!?!?!?
We must hold tough.
We should accept their offer.

#085
I really can't remember what I wanted to say but I felt that the process of communicating would proceed a lot faster and easier if the members could write their own comments since there were many times were I felt restricted by the set choices given to me.

#086
Yes and No answers
Can you hurry before time runs out?
What are our intentions?
Let's deduct their reasoning.
Please assess my responses.
I need feedback from all of you.
What are OUR disagreements, maybe we can learn from our mistakes.
I would like to accept this offer? Agree?
Remember to keep in mind our priorities.

#87
You are being contradictory
Our offer is nearly the same as theirs.

#088
Next time it might go faster if the members of the team were able to discuss a real conversation through the computer instead of merely sending messages. This could lead people off-track however.

#091
I thought that probably the hardest part of the negotiations--besides the negotiations themselves--was actually finding the messages and their corresponding numbers. Even though it was printed on a sheet and popped up when the cursor touched it, it still took some time to find the one I actually wanted. I thought that it would have been better if there was one option where you could type in what you wanted to say, because there were things I wanted to say that were not listed as options. I felt limited in that way. Other than that, I felt that it was a good activity.

#93
be reasonable

#094
I wanted to tell some people to get with it and try to contribute and that they should offer something

#96
yes
no
I'm confused
what should we do?